



# A sustainable University: Digital Transformation and Beyond

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## Abstract

Universities focus on digital transformation strategy to stay competitive in global education, staying competitive is taking on quite a different meaning in the 21st century – it includes the long-term implications of Covid-19 – the interaction of politics and economics, the emergence of China as a superpower, the end of neo-liberalism, the emergence of distributed autonomous organisations particularly in the area of research and education.

The impact of sustainable digital transformation in universities could be perceived as system and systematic. When the intangible but impactful influence is identified/recognized as a system, an applicable conceptual model could become designable and implementable. Conceptual models of digital transformation are vital to universities and business schools to gain sustainability amid rapid technological changes. However, there is paucity of practical, implementable and simple digital transformational models combining technologies, system and educational phenomena. This theoretical gap is sizeable, impactful and non-ignorable.

To fulfil this gap, this paper critically examines the need and the association between sustainable digital transformation and its impact in the universities, using an innovative qualitative grounded theory approach which uses three distinct coding procedures namely open, axial and selective followed by transcribing qualitative data. The researchers have proposed a conceptual model for sustainable digital transformation, new propositions by critically reviewing the latest but multiple cases on (a) sustainability (b) digital transformation (c) green technologies and (d) implementable approaches in the education industry/universities. How fast universities could develop dependable business models to cater for the rapid changes amid globalization of education has become an important issue. If the universities can explore a scientific approach to the design-developing conceptual model, then it becomes straightforward for the academic leaders to implement digital transformation process effectively without resource burnouts.

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Extended author information available on the last page of the article

The adoption sustainability in digital transformation/information technology is remaining an underdeveloped area. There is a need to develop an innovative architectural design (blueprint) to stimulate sustainable practice, reporting mechanism and its leadership implication. Once universities recognize the digital transformational capabilities, then they could transform into operational effectiveness, which is vital to their business sustainability. This research study points to the effectiveness of using a sustainable blueprint while designing, developing and implementing digital transformation projects in universities. Also, this paper developed numerous value propositions for green implementation of digital transformation as new research studies/potential studies.

**Keywords** Sustainability · Decision support · Sustainability measures · Digital transformation · Grounded theory · Digital transformation models

## 1 Introduction

The introduction to an academic paper, we think should first state the principal question, second motivate the reader to read further (if this fails, at least give a succinct account of the contents) and third, explain what the authors offer and to whom.

First, the main research question is, how digital transformation impacts sustainable development in universities? We address the research question by constructing a conceptual model derived from the literature.

Digital technologies facilitate the purpose of universities which is to be learning organisations. Learning is a democratic and co-operative activity, delving into academic disciplines, linking them, stretching beyond individual universities into local and global society. We offer a template or blueprint for transforming universities, Digital technologies as part of the asset base enable universities to become DAO's, that is democratic learning organisations (Angieri et al., 2020; Okubo, Jiahua and Onari, 2000; Rikken, Janssen and Kwee, 2019; Du Toit and Verhoef, 2018).

Sustainable digital transformation is applied, evolving and dominated by technological transformation. Thus, it requires significant research collaboration specifically in the implementation stage (Riedl, 2020). Since is a growing and niche domain, there is paucity for (a) research knowledge, (b) conceptual model and (c) measuring the accumulated impact and (b) grounding, determining and normalizing the applicability of digital transformation capabilities.

Technological transformation completely revolutionizes the current era and the digital transformation is anticipated to have a major influence on global education. Digitalization can create new market opportunities for organizations by refining the organizational value chain (Kilimis, Zou, Lehmann, Berger, 2019). How universities are going to react and capitalize on the market opportunities using sustainable digital transformation capabilities is regional, technology-driven, trend depended and associated with many other factors but not limited to universities' vision and business strategy. Thus, what type of sustainable digital transformation model/s could be adopted is continue to be unclear.

The factors influencing digital transformations are rapidly changing, the propelling forces such as artificial intelligence, big data, cloud computing and the internet of things are increasingly changing the landscape of digitalization (Bican and Brem, 2020; Abad-Segura et al., 2020; Akhmetshin et al., 2020), thus, how universities are going to encapsulate/react these changes using a combination of technologies in the form of sustainable digital transformation requires rigorous research, specifically to identify new implementable conceptual models and form new knowledge.

Virtual reality, online education, integration of WI-FI, managing e-waste and recycling of power/energy requires a new sustainable digital transformation blueprint. Further how the triple bottom line philosophy can be integrated into digital transformation requires a systematic approach and key performance indicators to identify, determine and trace sustainable digital transform performance (Du Toit and Verhoef, 2018; Bouza, 2019; Udovita, 2020). Further, unlike the other industries such as manufacturing, transportation and automobile the sustainability of digital transformation capabilities is still in the early stages (Mesquita et al., 2021).

Peillon and Dubrue (2019) Scholars of digital transformation identify potential, evolving and unique barriers but are limited to (a) technological and process, (b) lack of technical resources to implement/upgrade digital solutions (c) unwillingness to inherit digital innovation as a change, (d) lack of digital core-competencies-human resource-related challenges, (e) legal (Riedl, 2020). and (e) customer-oriented barriers- reluctant to share sensitive information on the internet, security violation continues to be a significant issue). Despite these challenges, how universities are effectively implementing sustainable digital transformation continue to remain as a black box or grey area.

Where does sustainable as it appears in the title, fit?

We note that sustainability is essentially dynamic both in respect to actions by strategists attempting to manage the university into the future and at the same time being able to adjust to rapidly changing circumstances and technology. Indeed, a blueprint for digital transformation may rapidly become redundant if advances in quantum computing meet the somewhat optimistic expectations of enthusiasts. For the moment, we circumvent consideration of such advances since at least for the moment the barrier to their intrusion is not so much the ingenuity of computer scientists but the enormous burden they impose on energy scientists.

We cannot offer a panacea for sustainable universities. But we attempt to distinguish those parameters or variables that they can influence from those they cannot influence, and to suggest how they might hedge against Blue Rhino if not Black Swan events. These two aims are encompassed in the phrase Digital transformation and beyond.

Jobs exist now that were beyond imagination only 10 years ago (Pingitore, Lorch and Hagel, 2018). and if they are to become sustainable, universities now should somehow learn to envisage the evolution of work over the next 10 years. Therefore, perhaps we should ask, why quantum transformation? And perhaps universities should envisage the emergence of distributed autonomous organizations, not only driven top-down by the oligopoly platform corporations (FAANGS) and spun off by digital companies that leverage FAANG platforms but also emerging spontaneously via open source and free platforms.

Innovation has reshaped education as teaching and learning process and nudged it into the status of a currency earning industry (Ross, 2020). The immanence of drastic climate change has steered firms, institutions and governments and governments reluctantly towards sustainability goals. Pupils have become teachers in this respect and organizations shown themselves to be with pupils with varying degrees of attention deficit.

The outlook is bleak, for universities, their staff and their students. Bleak even for those posing as the elite. Elite universities are elite in so far as their students are awarded admission tickets to the meritocracy and access to privileged employment networks: both of which they most likely have.

What do they universities possess that is distinctive? What is their core capability? <sup>1</sup>As a Vice-Chancellor of one of the largest Universities in Europe pointed out, the fundamental source of competitive advantage that universities possessed was the power of accreditation. That too is being eroded as a result of emergence of distributed/autonomous universities. Already universities in smaller towns and cities are outsourcing to privately-owned colleges in capital cities that are manned by hot-desking, home, and coffee shop working staff. Amid pandemic the conventional learning is severely impacted, this paradox has enabled universities to develop digital transformation as a priority and started associating with a larger workforce, through remote locations (Ivanov, 2020).

<sup>2</sup>A university rector of our acquaintance indicated succinctly; monopoly providers of degrees and certificates. And he pointed out; the monopoly power of universities is far along the road to privatisation. The major consulting firms have ready-built platforms which they can and already do leverage into the university market. And universities have adopted the lingo of the market.

Otherwise, their syllabuses mimic one another. Upper administrations of elite universities or posing or aspiring to be elite, are often appointed because they can access private and public funding, Academics are often hired as *piece-rate* producers of currently fashionable normal science, or if they fail at this, or prioritize their teaching as a priority, are penalised with overloaded timetables and overcrowded tutorials meant to be tailored to individual student needs. Of course, there are honourable and notable exceptions. But the median university teacher in our experience, concur.

Due to volatility in the digital education economy, we experience developing digital advantages are arguably impossible, breakdown in the execution of strategy underpin undesirable costs (40% cost of the value created by the new strategies) (Mankins, 2017). Digital transformation (DT) of organization has become a universal force that fundamentally changes/regulates the universities operation, the education system, in fact, the education society as a whole. It is ubiquitous. Universities/education institutions make high investments in digital transformation strategy (DTS) to be globally competitive. The efficient function of digital transformation intrinsically

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<sup>1</sup> One of the authors of this paper interviewed the vice-chancellor of the largest university in Europe about the source of building competitive advantages in global education. During an interview, he mentioned that the fundamental source of competitive advantage that universities possessed was the power of accreditation.

<sup>2</sup> A dean of a famous UK based university indicated to one of our authors during an interview, he mentioned the power of monopoly providers of degrees and certificates of higher education.

interrelate/leverage (a) digital transformation goals (b) technological dimension and (c) generating beneficial values. The benefits of building digital transformation for education are widely acknowledged and it has already become an inevitable propelling force (Mohamed Hashim, Tlemsani and Matthews, 2021).

We cannot offer a blueprint for sustainable universities. But we attempt; first to distinguish those parameters or variables that they can influence from those they cannot influence, and second to suggest how they might hedge against Blue Rhino if not Black Swan events. These two aims are encompassed in the phrase Digital transformation and beyond.

The main goal of the study is to identify areas of sustainability in digital transformation that should be focused on in the current and future stage in terms of industry 4.0, particularly in the global education industry. Transformation is defined as deploying/implementing new technological base mechanisms to influence the delivery of digital education.

It is well known that digital technologies require substantial energy use and somewhat on the contrary, sustainability requires energy saving. So some contradiction, here. Scale, scope, and learning economies – synergies in higher education. Scale economies: the resolution that we suggest is that existing digital technology (software and hardware) forms a platform that can be leveraged to add further innovative technologies, thus offering the possibility of gaining economies of scale and scope. We are pretty sure that this point is obvious to IT professionals – but to what extent do universities leverage existing assets such as their IT platforms, and what are the technical polyp possibilities for doing so.

Scale economies again: Leverage should perhaps be thought of not in terms of universities platform but in terms of a group of universities. Or maybe leverage possibilities exist between departments across universities. Or, and this might be the most interesting possibility, leverage across disciplines within universities and between universities.

Why might it be the most interesting?

Scope and learning economies: universities often think of subjects (say for example, economics politics maths statistics physics biology... And the humanities) as being individual silos that need to be protected in order to build up specialisms. This leads to over specialisation of academics, students, and universities – we are not sure how this over specialisation could be measured. But there is some evidence for example that economics is too narrowly specialised. So the idea of thinking in terms of platforms stretches over scale economies, scope economies and learning economies. And this thinking is certainly in line with the idea that in a fast-moving era – technology, climate change, resource use..., Et cetera education become more interdisciplinary.

The philosophy-sustainability is multidimensional, developed using (a) economic (b) environmental (c) societal (d) managerial (e) technological and (f) organisational. Thus, it has become a universal but inevitable force as the education industry is concerned. Specifically, applying the sustainability construct to digital transformation in education is deep, complex and time-consuming but strategically important; a necessity as far as globalised online education is concerned. Digital transformation in education underpins high fixed costs. Thus, universities need to focus on developing

digital transformation architecture future-ready while adapting calculated sustainable practices, so that, sustainable digital architecture can be prolonged.

In the literature, the beneficial impact of sustainable practices is very evident, it is closely associated with building competitive advantage, creating new employment, cost reduction and gaining differentiation across various industries (Signori, Flint and Golicic, 2017; Seele, and Gatti, 2017). One could argue those acknowledged impacts need a customizable approach to different domains, and their associated functions specific to an enterprise (Malesios et al., 2018). Digital transformation drives to minimal utilization scare and savings resource also avoid budget constraints (Powell and McGuigan, 2020; Carter et al., 2020).

Universities are increasingly showing serious concern about the sustainability element of digital transformation due to various pressing reasons but not limited to (a) involvement of high fixed cost (b) challenges of managing rapid technological changes (c) and the need to prolong the digital transformation solution while harvesting optimum beneficial outcomes. The sustainability of digital transformation (DT) is arguably a new trend, constantly growing at a rapid phase. Effectiveness of DTS is viewed as a competitive advantage by universities/educational institution not only stimulates world-class student experience but also generate consistent revenue. However, the notion of sustainability underpins the blueprint of digital transformation strategy is continued to be a less prioritised, ignored and less investigated area which is closely associated with universities strategic planning process (Khuntia et al., 2018). Thus, the researchers argue that the current state of digital transformation requires a new paradigm shift by bringing sustainability to the architecture level. What is that architectural paradigm shift? Why sustainable digital transformation will be a crucial element of the next generation of digital transformation strategies.

The unique changes such as (a) increasing usage of WIFI, (b) virtualizations, (c) accumulating e-waste (d) the need for efficient power management and (e) the necessity to innovative architectural models (architectural weightage) is imposing radical challenges on educational digital transformation strategy in higher education connecting Internet of Things. Unfortunately, in the education sector, the emphasis on sustainability practices particularly in the context of digital transformation has never been better. Thus, the philosophy of the sustainable digital transformation process and its implications need constructive dialogue specific to the education industry's complexities (Khuntia et al., 2018; Windsor and Royal, 2014; Dahalin, Hj Ibrahim and Yusop, 2017; Eccles, Ioannou, and Serafeim, 2014; Goyal, Rahman, and Kazmi, 2013).

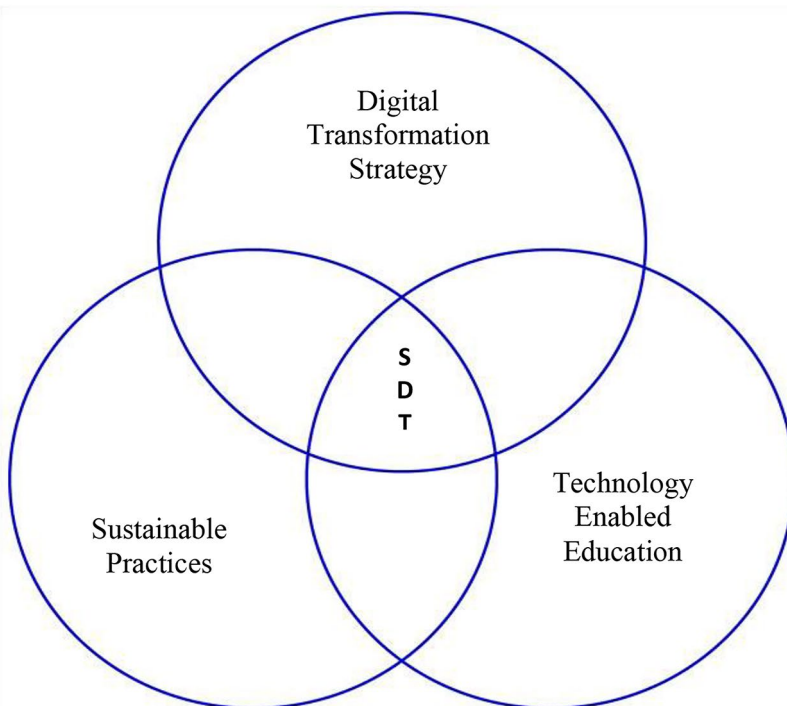
Phenomenons such as cutting-edge technologies, cloud computing, artificial intelligence, big data and virtual reality allure over attention and less emphasis is given to examines those insidious side effects (Alavi and Habel, 2021). While the previous researchers have made significant progress in terms of understanding the benefits of these technologies, the intricate 'sustainable side of digital transformation' remains relatively a less developed territory. The research giant Ernst & Young stated that in the year 2018 that 90% of companies are prioritizing the digital transformation strategy as a top priority. A similar type of research carried out by another consultancy Forrester confirms that 85% of organizations surveyed are committed to digital transformation investment, although 59% of the companies feel that they are already

late ([www.ey.com](http://www.ey.com) 2018; Ernest, Young and Ooi, 2014). Thus, there is a need for the researchers to address both the undesirable impact and inefficiencies of digital transformation in the current state. The ultimate challenge is to propose a road map to make the digital transformation strategy sustainable.

Interestingly, recent research has found that economic oriented sustainability measures have scored significantly lower than the measures related to environmental and social dimensions (De Steur et al., 2019). Thus, the researchers build a constructive argument that the application of sustainable practices, development of sustainability measures and the outcomes are contingent on a particular business/industry context. This philosophy cannot be an exception in the context of digital transformation projects in the education industry. This paradigm has already put pressure on the policymakers to prioritize the sustainable development of digital transformation in the universities/educational institution.

As stated, the present state of sustainable digital transformation literature thorough investigation linking (a) DTS, (b) sustainable organizational practices and (c) propelling force of technology as below incorporated in the van diagram.

As stated, Fig. 1 demonstrates that sustainable digital transformation is an evolving, applied and innovative field. Most importantly, the application of the digital



**Fig. 1** demonstrates the need for development of sustainable digital transformation literature source, (Nathan, 2009; Kim and Seo, 2020; Shum, 2010; Klumpp and Loske, 2021)

transformation strategy, sustainable practices and technology-enabled educations are relatively different but intrinsically interrelated. Thus, it requires a collaborative approach/view during research. Further, since the power of IT is rapidly growing/changing a niche topic for a sustainable university: digital transformation and beyond requires rigorous research in regular intervals to identify and recognize the key changes and the new development.

In this paper, the authors attempt to shed light on the significance of digital transformation strategy amid the key developments associated with (a) the digital transformation changes, (b) sustainable practices and (b) technology-enabled education. Further, the sub-variables associated consecutively with the digital transformation strategy, sustainable practices and technology-enabled educations are critically evaluated in specific sections in the review of the literature.

The epistemological position of this paper is to critically examine the impact of sustainable digital transformation strategy and its development using (a) literature review, (b) develop a ground theory model and (c) stem a data analysis mechanism. Authors have justified adopting this new and innovative epistemological position will lead researchers to develop relevant, new and innovative ideas around sustainable development in the universities. It should be highlighted that the key elements of the epistemological position of this paper span across introduction, literature review, methodology, analysis and conclusion.

The current state of the digital transformation process needs a critical examination of its economic role, impact and prolonging necessities. Therefore, the notion of sustainable digital transformation strategy/framework must consider the rapid challenges in the business environment, namely, (a) virtualization/ the use of cloud computing, (b) Integration of Wi-Fi technologies (c) reduce e-waste, (d) Build energy efficiencies and (e) Architectural weightage and new designs (goals of sustainable digital transformation).

A digitally competitive university/educational institution must be readily responded to global and unpredictable environmental changes, in this context, adapting to the new trend/phenomenon of developing a sustainable digital transformation process is increasingly becoming important. Researchers argue that there should be a fusion of knowledge among (a) digital transformation goals, (b) its applicability and practice, (c) developing project-specific sustainable indicators and (d) its relevance to Triple Bottom Line (TBL) for universities to be digitally future-ready. Nevertheless, to date, there is a very limited body of knowledge on the use of sustainable digital transformation ideas, practices, and methodologies for universities. To fill the gap this research study is carried out. As stated, the aforesaid reasons are similar in the corporate world and why 70% of digital transformation programs failed (Reeves et al., 2018). By inheriting the sustainability element underpinning the DTS the universities would be able to gain competitiveness as a result of higher efficiency of processes in universities. As such, the SDT's positive changes should be transformed into greater productivity, supreme flexibility, higher competitiveness and high-profit margin, rigorous security, and green ecology practices.



## 2 Literature Review

This section critically examines the practicality of sustainability dimensions, its necessity to DTS and how it leads build sustainability in universities from a global perspective. DT has become an important concept in strategy formulation. Further, the new trend/variable sustainability has increasingly put pressure on the DT design of the universities. Universities are giving increasing emphasis to make the DTS sustainable/consider as an important priority as part of their strategic planning process. However, the applicability of sustainability of digital transformation practice (SDTP) shows disparity across universities in the West, UK, Europe, Middle East and Asia (Mohamed Hashim, Tlemsani and Matthews, 2021).

A digitally transformed university must be able to effectively use the sustainable features of the strategy, technology, process and practice while responding to the dynamic changes. Such a sustainable digitalization road map must develop innovative ways to inherit sustainable practices from various dimensions and into organizational digital design. However, there is a lack of clarity among educational institutions on the underlying design of sustainable digital transformation and its utility. This paper (a) critically examines the key elements of sustainable digital transformation blueprint, (b) stresses the importance of developing sustainable digital measures, (c) draw relevant managerial implications for driving sustainable digital transformation and (d) proposes an empirical framework for spear leading the sustainable digital transformation process.

### 2.1 Online and Virtual Education

The global sensations such as World Wide Web, internet and virtualization, and social media have collectively made the DTS powerful for universities to enrich the students' experience in learning. But every element of those requires a notion of sustainability/green underpinning. It seems that global education has radically changed its character. Most importantly, its allures a specific segment of the workforce which can work with big four technological force of education, namely, (a) big data, (b) artificial intelligence, (c) internet of everything and (d) cloud computing (Grenčíková, Kordoš and Navickas, 2021). Further, universities expect their employees to put the virtualized practices as part of online education.

Virtual learning has allured the attention of the universities because of the programme delivery challenges imposed by 2019's pandemic. Since online education is going to be the future, universities must think about how they can make it sustainable the form of online and virtual deliveries. Proposing sustainable green practices cannot be taken lightly as part of the strategic planning process. SDTP is being a niche domain how to educate and what to educate on sustainability becomes a fundamental essential topic for universities. Thus, there is a need for the universities to examine how they combine humanistic qualities with virtual learning to amplify the students' collaboration and engagement (Powell and McGuigan, 2020).

## 2.2 The forces of sustainable digital transformation in Education

The driving forces of digital transformation in the education sectors are (a) global competitiveness of education and (b) monetary drivers (sustainable competitive advantages, quality of education and high profits) which are in line with the resource-based view of a firm (RBV). Also, external forces such as (a) investors pressure and (b) the need to meet standards and compliance (c) demands of the students fit within the view of industrial organizations view. However, building clarity on which drivers need to prioritize empirical research is necessary (Bican and Brem, 2020; Abad-Segura et al., 2020; Akhmetshin et al., 2020).

The biggest hurdles being (a) hierarchical organizational structure (b) lack of focus on rapidly changing students' needs (c) lack of applicable strategy (d) non-responsive organizational culture (Smagulov and Smagulova, 2019). Thus, the complexities underlying the successful digital transformation demands new/innovative architectural change in the blueprint level of digital transformation and organizational design (Patil, 2018).

Prior researchers, who have investigated successful digital transformation strategies, mostly over-emphasised the propelling force of technologies on digital transformation. But very little emphasis is given to a sustainable design of a digital transformation. The paucity of knowledge cannot be ignored because sustainable digital transformation is going to be a future-ready solution that provides the universities with a sustainable competitive advantage (Sia, Weill and Zhang, 2021). In this context, authors propose an empirical framework to be adopted while designing and implementing a sustainable digital transformation solution (proposition 1).

Ideally, the sustainability of digital transformation in universities must include (a) leveraging sustainable technologies (b) governance of sustainable digitalization policies and (c) sustainable education delivery models. Similar types of strategic approaches have been successfully adopted by digital transformation giants such as Google, Facebook and Netflix. This approach enables those organizations by delivering innovative, agile and customer-focused service propositions. We constructively argue that universities and higher education institutions must develop a cognitive understanding of the sustainable design of digital transformation in (a) designing the digital transformation and (b) put sustainable practices in decision making (Fig. 2).

Universities are increasingly selecting and applying their technologies based on three unique phenomena namely (a) Internet– Platform to connect, (b) world wide

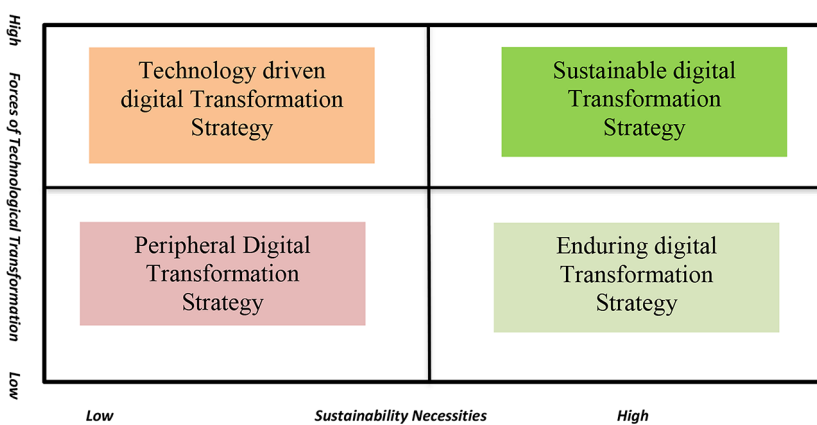


**Fig. 2** The underlying transformational approach for sustainable digital transformation. Source (Du Toit and Verhoef, 2018; Bouza, 2019; Udovita, 2020)

web– Publishing information and (c) wireless communication–virtual connectivity. These collectively resulted in emergence of new technologies/business models/new channels of communication. Green Internet is a scenario where we optimize internet usage to save energy by judiciously using available resources. The Internet is a magical place where everything is just a click away. In this digital age, we are driven by social media liking and fulfil our needs by the e-commerce industry. On this notion, the authors developed an empirical view of sustainable digital transformation design logic to demonstrate four distinct possibilities. The four distinct possibilities are derived from the literature and in the researchers' view, it stems from the fundamental idea to develop a sustainable digital transformation model.

The design logic diagram in Fig. 3 above explains four potential outcomes of DTS in the universities based on their appetite for (a) forces for technological digital transformation (b) the priority of sustainable necessities.

1. *Technology-driven digital transformation*: Greater emphasis on technology than sustainable necessities. This type of approach provides organizations to build their digital transformation strategy substantially on the propelling force of technology and its integration.
2. *Peripheral digital transformation strategy*: both the technology/sustainable priorities are low compared to the DTS necessities. Here, the primary objective is to achieve a preliminary vision of digital transformation with minimal cost while demonstrating some sort of digital capabilities for marketing purposes.
3. *Enduring digital transformation strategy*: Less emphasised on technological/innovative capabilities of the educational tools compare to the variable sustainability, this situation is achieved where sustainability policy development is strong while that is not translated in technological implementation.



**Fig. 3** demonstrates the design-logic positioning diagram (dimensions) for sustainable digital transformation, source- authors

4. *Sustainable digital transformation*: The ideal situation to prolong the digital transforming strategy by integrating sustainability, the paradigm this paper wants the universities to adopt while harvesting beneficial outcomes. This philosophical blueprint underpins the sustainable digital transformation strategy (SDTS).

Although scientific understanding of sustainable digital transformation is required to achieve digital sustainability practices, prolonging and managing sustainability is an efficient way also demands passion for sustainability (Starik et al., 2010; Audebrand, 2010). Attainment of a sustainable competitive position in education management demands universities their readiness to adjust to the macro-environmental changes.

There are considerable/significant research studies that have been conducted relating to the applicability of sustainability in various organizations/ and its context. However very few researchers have investigated the sustainability of digital transformation in the education industry, potential reasons are:

- (a) It's a subjective and complex process integrating various data points/information window.
- (b) The radical changes in information technology is unpredictable.
- (c) Less emphasis on sustainable practices goes into the strategic planning.
- (d) Sustainability on digital transformation is a niche and evolving domain.
- (e) It combines the integration of technology, sustainability, process and policies and human resources.
- (f) Developing the right combinations of key measures to build an efficient sustainable practice is relatively a challenging exercise (Du Toit and Verhoef, 2018; Bouza, 2019; Udovita, 2020).

The toxicity of various materials drives the modern-day digitalization process. E-waste is one of the major issues of any digital transformation project; this issue can no longer be solved by particularly tossing the out-dated hardware items into nearby trash. Thus, there is a greater emphasis on e-waste solutions particularly in the universities; budgetary consideration has become increasingly a prerequisite while implementing digital transformation initiatives. Meaning, universities should mandate proper disposal of e-waste or recycling system as part of the digital transformation framework.

### 3 Sustainability of digital transformation- Theoretical view

#### 3.1 Sustainability is a global variable

Various researchers have investigated the applicability of sustainability revealed that the pragmatism of sustainability is contextual. Thus, it is important to develop a holistic perspective of sustainability and its applicability at a global level across both product and services industries so that the review of literature can be viewed as the guideline for the universities to sensibly inherit their sustainable practices.

Khuntia et al. (2018) investigated green IT investment, their findings confirm a positive relationship between IT green investment and higher profit margin. Interestingly, they explored the positive relationship which was partially mediated by the diminishing margin of IT equipment usage and its energy consumption. Finally, this research signals that operational green IT implementation minimises the consumption of power energy and profit impacts.

Remondino (2018) who investigated the importance of developing key performance indicators in the healthcare industry to evaluate IT sustainability in different areas has stated the applicability of sustainability can go beyond the triple bottom line. He further emphasized adopting a MOTES (managerial, organizational, technological, environmental and social) framework. This perspective triggers the researchers to develop education base specific sustainable practices. Another research examined the telecentre models and their influence on sustainability in the emerging economic situation indicates that the telecasters should focus on three distinct integrated areas, namely, (a) social, (b) economic and its collective changes/conditions to gain long term sustainability (Windsor and Royal, 2014). A critical investigation on firms IT capability reputation of IT workers demonstrates that when IT executives develop a superior reputation with the external stakeholders, it is likely, that the top management reciprocates with internal legitimacy at work. Further, it seems the idea that the IT organizations that develop such a culture of reciprocity with their technology works are more likely to sustain their IT capabilities (Lim, Sarantopoulos and Wirjanto, 2013).

Bachoo et al. (2013) who critically investigated the empirical relationship between the construct sustainability and cost of capital employed/predicted future performance in Australia concluded that there is an inverse relationship between the variables (sustainability disclose and cost of capital employed). But this research identified there is a positive relationship between expected future performance and the quality level of sustainability reporting. Further, the researchers investigated the sustainable development principles in utilizing organizational IT resources found that major advantages resulting from the efficient use of energy and the demand were constantly growing (Chmielarz, 2017).

Perez-Lopez et al. (2015) stated that the relationship between sustainability and its practices using a qualitative approach in the organizations is positively influenced (motivated) by both internal and external practices of the organization. Mahmood and Orazalin (2017) studied the empirical relationship between the characteristic of corporate board and sustainability reporting in an emerging economic situation, specifically in the oil and the gas industry identified that the characteristics such as (a) board size and (b) gender diversity as critical factors in determining the scope of sustainability and its quality practices. Loannou and Serafeim (2017) evaluated the influence of sustainability disclosure regulations on firm disclosure practices and firms' valuations accomplished that even without the existence of reliable sustainable practices organizations/firms attempt to seek the qualitative properties of comparability and credibility.

Recent research investigated the 2nd wave of sustainability concluded that to achieve sustainability in corporate IT services firms should adopt sustainability-based innovation and this process is viewed as an IT services enabler (Harmon and

Moolenkamp, 2012). Swarnapali (2018) critically examined corporate sustainability reporting and firms' net value in a developing economic situation established a positive and relatable relationship between the variables sustainability reporting practices and overall company's value.

### 3.2 The association of Triple Bottom Line and its Impacts on Sustainability

There are numerous research studies conducted about the use of sustainability indicators and their applicability in Information Technology projects (Boudreau et al., 2008; Dyllick and Hockerts, 2002). These indicators are used as the technological strategy, aiming at obtaining increased economic performance and efficiency of the project results (Aarseth et al. 2017). To ensure our constructive argument on sustainable digital transformation comply with the dimension of sustainability (i.e., economic, social, and environmental), we baseline the applicability of the theoretical argument of the triple bottom line. Elkington (1998) argues that for a project (in this case digital transformation project) to be successful, it must be ecologically correct, economically viable and socially fair (Fig. 4).



**Fig. 4** demonstrates the theoretical view of sustainability Triple Bottom Line (TBL). Source (Elkington, 1998)

The utility of TBL sustainable principles to the digital transformation significantly contribute to the education institution/universities to increase the capabilities, competitiveness, and control mechanism. Thus, developing the right combination of SDTS is the first the very first step of positioning and prioritizing the critical element of sustainability, but in the long run, builds competitiveness by diminishing the key drawbacks/flaws in the organizational planning and organizational management process. Indeed, an increasing performance can be achieved using sustainability indicators. The inheritance of key performance indicators in a controlled organisational environment (measurement process) is the fundamental basis of SDTP.

We argue that while the sustainable digital transformation of social and environmental dimensions needs to be intrinsically interrelated with efficiency factors of the information technology projects, however, the economic dimensions are viewed as of superior/significant importance due to the amount of fixed cost investment. To achieve this success, we require the necessary support of the top management to effectively institutionalize the philosophy of.

Triple Bottom Line (Mesquita et al., 2021) (Table 1).

How universities relate sustainable indicators to achieve and maintain the sustainability of digital transformation in digital transformation/IT projects? Specifically, in Information Technology, sustainable practices are directly and realistically linked with project management practices, because universities implement and achieve sustainable digital transformation process as a project management practice. So, it has become necessary in recent years. Thus, there is a need, specifically among the universities and the educational institution to develop sustainable indicators/practices worldwide (tool/s to support), enabling the companies to gain sustainable performance namely in the (a) social (b) environmental and (c) economic dimension.

As part of the digital sustainability, strategy Universities need to focus on systems to monitor the trend in power consumption, developing energy efficiency and reducing e-waste. There's a significant need to engage IT professionals to build sustainable digital solutions.

**Table 1** The Triple Bottom Line measures of sustainable digital transformation Source (Mesquita et al., 2021; Boudreau et al., 2008; Dyllick and Hockerts, 2002; Aarseth et al. 2017)

Economic	Environmental	Social
Return on investment	Green technology	Retain ability of the students
Digital agility	Reducing e-waste	Protection sensitive information
Increase in post digital transformation revenue	Using recyclable energy	Ethical information practices
Energy efficiency	Reuse of hardware items	Knowledge management and organizational learning
The role/adoption of Wi-Fi	Use of cloud	Students' development
The use of big data	Green technologies	

## 4 The Need for Sustainable Digital Transformation - Blueprint

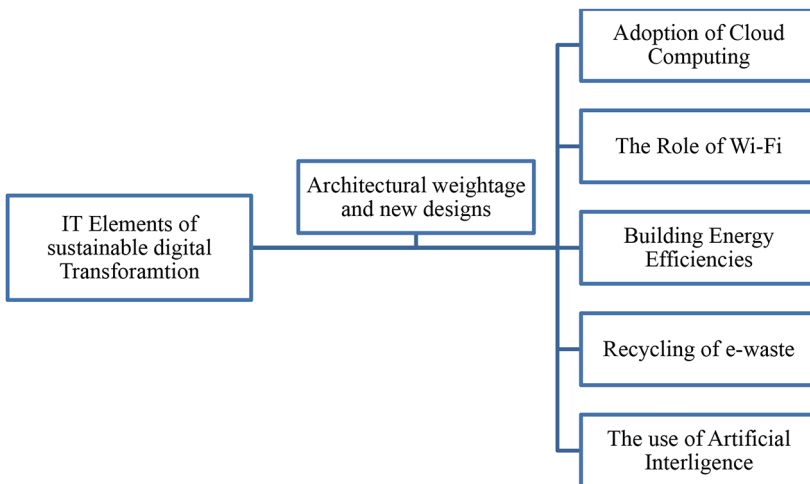
New and rapid development in the IT infrastructure has put universities under pressure. It challenges them to constantly improve to cope up with the demand for efficient information exchange. This phenomenon also made it possible for the universities to integrate interdisciplinary variables, particularly cloud computing possible (Duvnjak, Gregorić and Gorše, 2020). This transformation development resulted in new disciplines known as -education informatics- that combines (a) cloud computing (b) data science and (c) artificial intelligence. This emergence phenomenon enables universities to build new business models, simulations and student-driven user interfaces.

### 4.1 The need of new architectural view/weightage

The application of DTS has transformed and modernized the delivery of education to a significant level. As stated previously, we propose that the rapid global changes of educations demand the universities to inherit a new architectural paradigm as below incorporated. The scalability and extendibility of the architectural weightage are depended upon the robustness of integration interconnecting the key elements such as (a) cloud computing (b) the role of Wi-Fi, (c) building energy efficiencies and (d) recycling of e-waste (Fig. 5).

Source - (Mohamed Hashim, Tlemsani and Matthews, 2021; Maleshefski, 2007; Lavoie, 2018; Graa and Benhamida, 2020).

As captured, the key elements of SDT require a base lined approach to achieve superior digital transformational outcomes. The authors propose the following road-map/ approach to the sustainable digital transformation process. We claim that SDT



**Fig. 5** Highlights the IT elements of Sustainable Digital Transformation. Source (Mohamed Hashim, Tlemsani and Matthews, 2021; Maleshefski, 2007; Lavoie, 2018; Graa and Benhamida, 2020)



roadmap requires an architectural/innovative change from the existing digital transformation design in universities.

## 4.2 The adoption of cloud computing/virtualization and sustainability

The inheritance of virtualization and cloud computing (cc) has radically reduced the (a) workload and (b) power consumption. Particularly virtualization helps the managers to reduce the number of machines and servers' companies need. This phenomenon has also reduced the overall fixed cost involved otherwise inters of assembling the hardware infrastructure.

Digital transformation has altered how universities estimate/determine the budget. However, virtualization also leads to the deployment of multiple operating systems on a computer. Thus, the power consumption is expected to be on the high side which is a newly emerging problem that requires a practical solution, but it is a new equation.

Interesting statistics, for every 200 servers virtualized a company stand to save about US\$ 1 Million plus over three years. It means that even smaller-scale companies can benefit too. However, virtualizing on a small scale or using one computer is only a small step toward gaining energy efficiency and financial saving – achieving sustainability. Despite the importance of digital transformation for universities both the content and delivery mechanism, the universities may not understand the cost implications, still may not estimates the cost wisely based on the priorities (Dugan, 2002).

We argue based on the university digital priorities if the cloud computing used to build the digitalization consumes a large portion of the annual budget, then it needs to be considered as the operational expense rather as opposed to capital budget (Dugan, 2002; Maleshefski, 2007). Interestingly, researchers also have found that the amount of energy required to cool down/stabilize the servers/data centre is much higher than the total sum of computes being used at a normal room temperature. Also, the power consumption for the high-end powered computers is on the high side (Maleshefski, 2007).

We claim that the Virtualization of cloud technologies introduced to reduce the number of physical servers and computers (hardware devices), which could be viewed as one of the centric elements of the SDT blueprint. But how it goes with the power consumption, cooling mechanism and its regulations require significant research (proposition 2). How about the adoption of the public cloud so that students start to use subscription models? If they would there, the universities attempt to achieve just in time capacity, improved student experiences, within the predictable or estimated cost. While the cloud is not for everyone, but the adoption rate is very high.

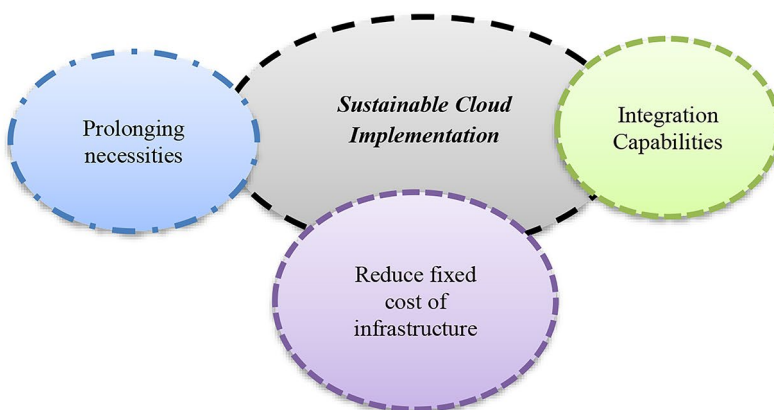
The sensation of cloud computing is viewed as the new wave in global education (Sultan, 2010). Universities are increasingly building cloud-based models to share valued information conveniently over pools of networks (Militaru, Niculescu and Teaha, 2013; Ramachandran et al., 2014). Further cloud-based solutions enable universities not only to share information but also to deploy over an array of networks (Mell and Grance, 2011). Most importantly, cloud-based solutions have enabled universities to (a) provide world-class learning (b) liberal education and (c) develop

global programme management capabilities (Klug, 2014; Ramachandran et al., 2014) (Fig. 6).

### 4.3 The Role of Wireless and Wi-Fi

WI-FI technology has changed the face/landscape of education rapidly. It creates entirely a new approach to learning worldwide, meaning; particularly the orientation of education has undergone tremendous change. Garner stated that about twenty-one billion devices were connected in 2020. Specifically, 63% of the internet traffic was generated by the WI-FI connected clients, in 2017. It was recorded this was the very first time in history that wirelessly connected devices surpassed wired devices. This indicates wireless as a technology is a new network and it is going to dominate the education sector, it is indeed a driving adoption (Lavoie, 2018).

WIFI has the potential to take internet every place where the university students live, or internet could go. Internet usage rates generally equal or follow the same patterns across countries as good as the computer usage rates. The super-speed wireless network enables students to access high-definition video/associated technologies across the work. Virtual learning, open educational tours, informative online education sessions are realistic and frequently used by the modern day's education system. Generally, in education scale and quality is believed to be negatively correlated, however, the availability of broadband/WI-FI is making it possible to think that there is a positive correlation between education and quality. Why do the students/adults who follow the courses enable the university to shape the course in a way that enables the university to customise the delivery of the course in a most individualistic way? It leads the university to stimulate a highly customizable experience, largely.



**Fig. 6** demonstrates the key elements of cloud- based solutions. Source (Grenčíková, Kordoš and Navickas, 2021; Mohamed Hashim, Tlemsani and Matthews, 2021)

Wi-Fi technology also enables people/students worldwide to be connected using multiple and distinct hardware items. It favours excessive learning via the internet. It also provides an opportunity for the students to overcome the screening hurdles students would go through otherwise, however online education and the use of big data is pre-request. In other words, it creates or leads to enormous worldwide educational opportunities. Wi-Fi technology also creates more opportunities for the students to demonstrate their skills to the global audience (uploading/downloading). The E-bay model to education connects the teachers and the students worldwide. Broadband/wireless technology has the ability to resolve two dramatic problems or that are going to confront the world of education.

- (a) It broadens the scale of education – Is being able to provide education to enough students around the world. Make the classroom accessible from anywhere/also provide the luxury of attending a classroom/session while sick or unattainable positions/while travelling. It is a critical element underpinning online education. The number of students who follow the educational courses online is growing at a staggering phase. The quality level of lecture delivery also can be seen in this.
- (b) Cost-saving or cost reduction mechanism for many digital transformation projects in the university (Internet cost, the cost of optimum reuse of hardware devices connected depending upon the policies).
- (c) Create opportunities to collaborate – It creates more opportunities for the teachers to share files collaboratively among a group of students/collaboratively and effectively using email, discussion thread or chats uploading/downloading of multimedia files are possible.

With the remodelled wireless-enabled classroom or educational delivery, there is a need to measure the impact of architectural consideration of wireless. Another type of technology that plays a significant role in suitability, the adoption of wireless – reduced the need for physical capability significantly. Also developed more collaborative workplaces, demand for more reliable and accessible wireless becomes the norm. The selection of building layout and the materials utilized to build the buildings can significantly impact the layout. Predictive tools are necessary to overcome signal issues.

One of the key critical challenges of Wi-Fi as far as the universities are concern is in a testing wide range of Wi-Fi devices students, it requires lots of traditional WIFI testing depending upon the ISP provider. Particularly, (a) range testing and (b) multi-device testing are critical.

Managing the network traffic is also viewed as a pressing issue. This enabled the hardware manufacturer to design develop the Wi-Fi port as a mandatory element as part of the specification. There are also security concerns associated with the WIFI technology; users are sceptical that hackers have been able to crack the basic data-scrambling software that is imparted in most Wi-Fi devices. So that there is a tendency that the sensitive information transmitted via the air might be snooped. We propose, there is a need to further investigate the fragility of Wi-Fi and exposure to information leakage (proposition 3).

#### 4.4 The need for efficient power system

Electric power energy is one of the fundamental utilities for the survival of education delivery both online and offline. Thus, electricity is viewed as an economic utility (Graa and Benhamida, 2020). The power is relatively costly in many countries, we experience that its availability fluctuates. Universities attempt to reduce the energy consumption to a minimum level, primarily aiming at reducing the operational cost or to help the environment or in few cases the combination of both. Digital transformation process or strategy demands a combination of high-end servers dedicated to carrying out distinct tasks, specifically (a) information processing (b) memory management and (c) storing data. Thus, these types of servers consume lots of power.

Thus, power management plays a critical role in not only improving energy efficiency in server management systems. Running complex and high-end educational software applications with high-definition multimedia features or critical web services on those servers is still a challenging process due to the transition tasks between those servers require higher power consumption (Wang et al., 2020). Thus, there is a necessity to build a run time energy efficiency system. Thus, universities increasingly seek optimization methods to best manage power-system. The cost on building an energy efficiency system and its integration on digital transformation require in-depth investigation as the implementation of an efficient power-management and its optimization are highly costly (proposition 4).

Particularly, Dell has manufactured various desktops and notebooks that consume less than 5 watts in lower power mode. Digital transformation experts must seek hardware items that consume less power while in the standby or sleep mode/stage. Researchers have figured out another way to diminish the power consumption is to restrict the use of screen savers, which are standard power drains (Maleshefski, 2007). Is the power management policy explicitly emphasising the importance of building visibility among organizational stakeholders continue to be a major question mark? Utilizing the power saving features build or standardise as part of the enterprise operating system (Windows and Linux). The challenge is not all the application utilized in the digitalization is power saving enabled/ organizations need to go digging into it.

When attempting to build sustainability in the digital transformation process power-saving capabilities is a critical priority. Meaning electronic productivity assessment becomes a priority. The regulatory standard to assess the electronic is becoming increasingly important. The author argues that both the power consumption and electronic productivity assessment needs to be integrated. In 2006 Carnegie Mellon University had indicated that particularly in the US about 70 million computers in US in the landfill stage, it may cause contaminate groundwater unless recycled. Apple has banned using toxic materials while manufacturing its hardware items. Cadmium, mercury, and asbestos are on the list. In 2006 apple had stated that they have stopped using CRT monitors (Maleshefski, 2007). We propose it is strategically important for the universities to build an energy power management system as a functional unit power commitment but as a collaborative digital transformation initiative that leads to optimal power flow, ultimately leads to economic power utility dispatch (Graa and Benhamida, 2020).

#### 4.5 E-waste - control, reuse and recycle

Managing IT resources, controlling and regulating e-waste, increase the percentage of reuse and recycling mechanisms have become critical factors of operations management. Particularly, e-waste has become a severe threat, in turn; organizations are forced to explore solutions to resolve this vital issue as part of their sustainable management goals (Chmielarz, 2017).

Few countries have serious consideration for e-waste and the need for recycling solutions. Establishing an advanced process to recycle e-waste at the societal level is continued to be a challenge. The USA has established noteworthy achievements in recycling hardware infrastructure (servers, laptops, computers, and other devices), they charge a \$ 10 recycling fee on consumer electronics, and the money collected would be given to the recycling agencies to motivate collectors and recycling products (Maleshefski, 2007). However, to what extent this is feasible in emerging economies? Would universities consider the recycling mechanism as a serious need of digital transformation process unless initiated by the government? How government can help encourage collections of not used or expired hardware items are research worthy topics. Does this mean universities need to start allocating budgets for their recycling strategy?

We require a change in our mindset; we should start thinking about allocating a budget for recycling. Thus, researchers argue that how universities can adopt a sustainable digital transformation framework associating with e-waste must be considered as a new proposition. Sun Microsystems and Microsoft being actively involved in terms of promoting the recycling of hardware items is an indication of stressing the importance of the e-waste stream. In the year 2016, Apple has recycled 13 million pounds of e-waste, which is almost equivalent to the 10% range of apple products sold since 2000. This percentage is anticipated to increase at a 3% compound rate per annum (Maleshefski, 2007).

The use of various electronic hardware items creates the demand for various electric energy sources insufficient capacity. The demand for electric power has been increasingly growing along with the growth in global education, the transformation of education and the standard enhancement of education. The designers of power management and decision-makers are facing considerable pressure to deal more effectively while designing and implementing digital transformation solutions (Cossette, 2002). This pressing issue is resolved able, but complex requires a scientific approach to electric power management and optimization (Graa and Benhamida, 2020).

#### 4.6 The use of Artificial intelligence capabilities to lead and regulate sustainable digital transformation

Universities should develop an intelligent approach in terms of how artificial intelligence can be utilized to build sustainable efficiencies. We propose this approach would enable the universities not only to develop necessary measures and trace the progress of sustainable practices as part of the STD so that the deployment of AI becomes a centric element of DT from the design level. As stated, if universities

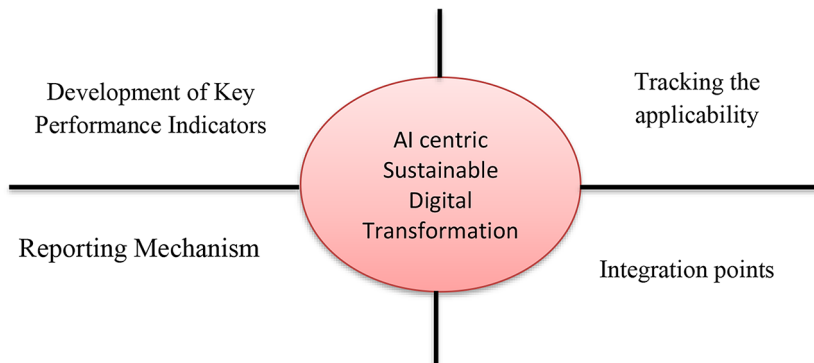
would adopt an AI approach not only for creating digital efficiencies but also a control mechanism to develop sustainable measures and its reporting, constantly, this paper also raises concerns about artificial intelligence usage in resolving the need of inheriting SDT, its benefits, long term analysis and incremental innovation.

In this context, we argue that the effective implementation and utilization of the DTS is largely dependent upon the quality of information available/used to make appropriate decisions by the universities. Because AI-enabled computers are well capable of resolving SDT tasks such as (a) monitoring sustainable practices (b) performing complex data analysis (c) user-friendly presentation and (d) information storage and retrieval. So, it is a matter of time to explore the artificial intelligence capabilities in SDTS within the mentioned tasks.

We recommend that the integration of AI capabilities with the sustainable transformation blueprint would enable universities to embark on SDTS reporting practices. We identified there are distinct avenues to utilize AI capabilities as specified in the diagram, in the next page (Fig. 7).

#### 4.7 Development, use and reporting of sustainable digital transformation measures

As stated previously, the development, use and reporting of sustainable practices are viewed as one of the key drawbacks. Thus, there is a pressing need to design-develop sustainability-oriented digital transformation measures (SODTM) base-lining the TBL. We propose along with a blueprint of SDTS organizations should integrate their reporting mechanism by integrating reporting policies and measures. The below-incorporated table below reveals the potential measures of SODTM for universities and educational institutions. This table demonstrates the practicality of SDTS on the global scale and its closely associated trends (Table 2).



**Fig. 7** the use of AI in SDTS blueprint design. Source (Duvnjak, Gregorić and Gorše, 2020; Mohamed Hashim, Tlemsani and Matthews, 2021)

**Table 2** illustrates the applicable key performance indicators of the sustainable digital transformation strategy

TBL Dimension	Key performance indicators of sustainable digital transformation	Comments
Economic Indicators	Return on investment Digital agility Increase in post digital transformation revenue Energy efficiency The role/adoption of Wi-Fi	65% of the world the network traffic is generated via Wi-Fi in 2020
Environmental Indicators	Green technology Reducing e-waste Using recyclable energy Reuse of hardware items Use of cloud Green technologies Emissions of carbon dioxide.	New technologies lead to a rate of 9–26% for avoided transportation.
Social Indicators	Retain ability of the students Protection sensitive information Ethical information practices Knowledge management	
Technological Indicators	Modifiability Reusability Extendibility	
Organizational Indicators	Diminish cost Increase efficiency Increase productivity	
Managerial Indicators	Development of transparent sustainable policies Sustainability Reporting Practices Use of AI and big data capabilities	

Previous qualitative research has found that about 90% of digital transformation projects used ROI measures/indicators directly deals with the financial performance. An increase in total revenue and profit margins were also identified as realistic measures (Mesquita et al., 2021; sánchez, 2015).

#### 4.8 The importance of integrating digital transformation with IoT

The global spending on the Internet of Things (IoT) is projected to be between \$2.7 to \$6.2 trillion by the year 2025 (Tarabasz, 2016; Kiryakova et al., 2017). IoT and

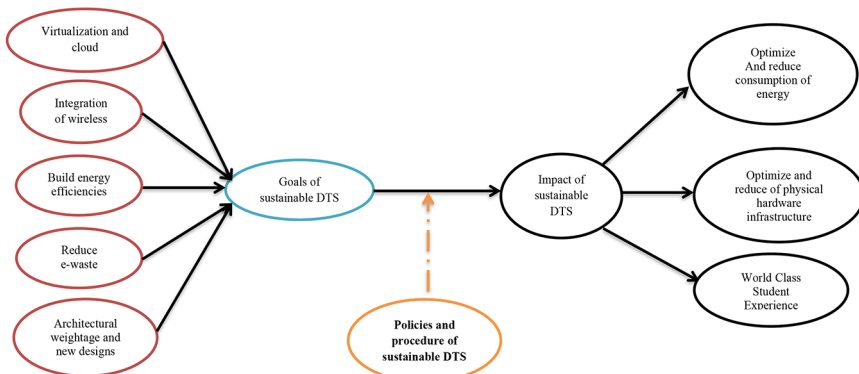
the Internet of Everything (IoE) are increasingly contributing to engage students' activities without their physical availability by connecting various handheld devices, operating systems and browsers (Abad-Segura et al., 2020). Thus, in the development of sustainable digital transformation blue-print, the integration of IoT and IoE play a vital role.

#### 4.9 Variable View of fundamental model: SDTS

The fundamental model demonstrates the variable view of SDTP, the blueprint. The variable view stems from the idea of integrating the goals of sustainability, the mediating impact of policies and procedures and the beneficial outcomes for universities particularly. The proposed variable view of design, development and implementation is simple, practical, and multidisciplinary and assures sustainable outcomes. It includes two distinct measurement models and one structural model from the structural equation model perspective (Fig. 8).

## 5 Methodology

This research aims to propose a new systematic methodology to examine the impact of sustainable digital transformation in universities using the grounded theory approach (Strauss and Corbin, 1990; Strauss and Corbin, 1998). The widely acknowledged qualitative research method-grounded theory enables the researchers to causal map the impact of digital transformation by capturing its core elements and develops a roadmap and way for applying digital transformation capabilities to find its core elements in a global view. There is a necessity to explore and ground the theory about how SDT capabilities impact universities in a global view, because,



**Fig. 8** Variable view of the derived fundamental model. Source (Mohamed Hashim, Tlemsani and Matthews, 2021; Riedl, 2020; Bican and Brem, 2020; Abad-Segura et al., 2020; Akhmetshin et al., 2020; Du Toit and Verhoef, 2018; Bouza, 2019; Udovita, 2020)



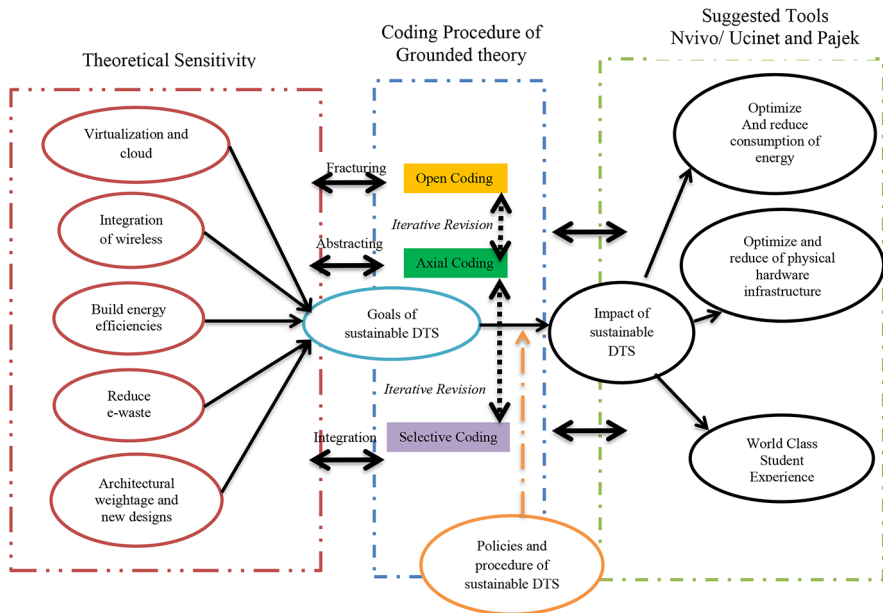
the absolute impact of SDT is contingent on various factors but not limited to (a) IT capabilities, (b) innovative systems, (c) tech-savvy human resource, (d) propelling force regional IT growth, (d) introduction of new technologies, (e) industry itself and (e) education-environmental changes. Thus, normalizing the unique/regional impact of DTS requires a grounded theory approach to investigate the conclusive impact of DTS particularly in the education sector (Tsai, Lin and Su, 2011).

The causal independent relationship among the fundamental model of SDTS lays the foundation to explore the influence of SDT on universities, collectively the global education enterprise. Thus, researchers have the luxury to treat a university as a case approach or cross-sections to demonstrate the robustness/utility of the grounded theory approach. In the age of digitalization, universities run unique/innovative SDT models that are different relative to the conventional models; hence universities are worthy case/s to examine. A grounded theory of qualitative research method is to be used to collect, analyse and interpret complex data amid the sustainable digital transformation education era. The grounded theory approach is used by the previous researchers to investigate/predict the behavioural pattern of human/system and business pattern as a case which is very similar to the real-world phenomenon DTS impacting universities (Tsai, Lin and Su, 2011; Strauss and Corbin, 1990 and 1998).

Data analysis procedure comprises of theoretical understanding, coding process and the tools requirement. Diagram 9 on the next page illustrates the holistic view of the data analysis approach and the architecture proposed for this research study. Three distinct coding types are proposed to analyse and synthesize the research data. For each coding method, we relate existing theories to provide more meaning- which is titled theoretical sensitivity. As far as the authors are concerned, the theoretical sensitivity of this research primarily derives from the existing digital transformation literature and secondarily from their professional experience in the educational experience. As far as coding procedure is concerned, we recommend three distinct codings, namely (a) open coding, (b) axial coding and (c) selective coding with a reliable level of data transcribing. This approach is carefully chosen after having considered the complexities associated in terms of conclusively concluding the accumulated impact of DTS on universities performances (Tsai, Lin and Su, 2011; Strauss and Corbin, 1990 and 1998). Open Coding (OC) is a process is responsible for decomposing, scrutinizing, classifying and conceptualizing data. This process is required in this research to decompose the SDT literature/identify categories, properties and derived sources. Axial Coding (AC) is a procedure performed once the open coding is implemented. It is a unique way of establishing connections between categories.

This is achieved by connecting coding paradigms such as context, action, outcomes and interactive strategies. Selective Coding (SC) The procedure filters, select and recognize the core coding category. This process validates the relationship between the categories and also develops categories that require further fine-tuning. As stated, the below-incorporated diagram illustrates the data analysis architecture/approach using grounded theory (Fig. 9).

Although this paper provides mostly the theoretical emphasis on the applicability of sustainable digital transformation in the education industry, it raises the critical question of the digital transformation implementation in ICT environmental issues, its sustainable benefits for strategic analysis. Thus, this capture encapsulates



**Fig. 9** Analyses the data analysis architecture of SDT impact in Universities, Source – (Tsai, Lin and Su, 2011; Strauss and Corbin, 1990 and 1998; Cossette, 2002; Mohamed Hashim, Tlemsani and Matthews, 2021)

an extensive review of literature in this field. Extensive literature on (a) suitability (b) digital transformation and (c) sustainable information technology practices are captured to an adequate level. Thus, researchers have performed extensive desk research. Also, this paper has developed numerous future research propositions for future ready SDTS based on the synthesis of literature.

This paper proposes a qualitative conceptual model for sustainable digital transformation for higher education industry which is carefully derived/nested using existing literature. The proposed qualitative model requires comparative testing to determine the applicability of sustainable digital transformation in the global educational landscape. Sustainability on digital transformation is relatively a niche domain, thus, adopting a grounded theory as the methodology to identify the existing themes and emerging themes to develop a theoretical model is important. Deploying transcribe the data using qualitative approach- using Nvivo, particularly to develop the new theoretical model is essential. Future researchers also may consider a content analysis approach as the data analysis technique, because enough content on sustainability/digital transformation are available in the form of web pages and document reports.

## 6 Findings and Discussion

Let's start with prospects. It is evident that DTS generates new business opportunities, build competitiveness, supporting revenue growth and leads to develop operational capabilities (Gimpel and Schmied, 2019). Thus, it has become a top priority among universities. However, the impact of DTS is regional or contextual (Rajesh, 2018; Du Toit and Verhoef, 2018). However, sustainable development penetrated via digital transformation across global industries is still in the early stages (Ufua et al., 2021; Lositska, Melnychenko and Bieliaieva, 2022; Bican and Brem, 2020; Pasqualino, Demartini and Bagheri, 2021). Universities top managers must develop informed estimates/calculations in order to design-develop relevant sustainable digital transformation strategies to bridge the digital strategy gap, so they need (a) digital strategy, (b) sustainable practices and (c) reliable educational technologies.

A well designed and effectively implemented sustainable digital transformation solution will assure predictable results for universities, i.e. potential revenue, student retain-ability, profitability. However, being able to extract relevant metrics/information via DTS requires adequate tools such as AI, CC, big data and IoT. Also, identifying and determining the hardware devices, segmenting the users based on the use of operating systems and continuous improvement on security/protection policies are also critical components of digital transformation in higher education (Rajesh, 2018; Haake, 1999).

The main aim of the sustainable digital transformation is to develop sustainable competitive advantages, however, when considering the dynamism closely associated with the digital transformation, building advantages in the state of a globalized digital economy is highly challenging. Meaning, very few advantages can be prolonged to a longer period. It needs to be highlighted that sustainability as a concept in the digital transformation, specifically in the education industry is underdeveloped, because it integrates (a) impactful changes (b) usage of technology and (c) make it sustainable using policies, development of key performance indicators. Further, developing/introducing sustainable design using such as e-waste, green internet and new/innovative architectural changes require high fixed investment costs. Thus, arguably the domain sustainable digital transformation makes slow progress.

Digital transformation strategy enables higher education faculties to use technology-based tools to facilitate engaging students, blended learning, perform virtual group activities and interactive learning (Trinidad and Ngo, 2019). However, it has become a need for universities to develop and integrate green sustainable technologies.

We propose, integrating and implementing sustainable DT policies should be a key element of the DTS blueprint, and further can be linked to AI capabilities to develop realistic projections about virtual education deliveries in the universities. Further, researchers have identified that digital transformation projects/initiatives seldom fail for technological complexities but to lack of managing the human resources (Alavi and Habel, 2021). In this context, universities must introduce a system or empirical models to effectively integrate the utility of human resources to amplify the beneficial outcomes of SDT. Specifically, we propose that future researchers may introduce a

balanced scorecard approach to determine the effectiveness of SDT implementation, enabling the human indicators to play a centric role (proposition 5).

By developing high-speed Wi-Fi, universities have the potential to make a social change that diminishes or eliminates the digital divide among the social classes (Middleton, and Chambers, 2010). We propose that that approach enables the equitable distribution of education in the knowledge economy, which leads to better economic performances. Also, the adoption of public Wi-Fi may enable the universities to produce superior but beneficial outcomes by integrating a larger proportion of the society connected with education. From the researcher's perspective a university must be viewed as the immune system for a society's knowledge base, thus the SDTS.

Investment in DTS is relatively expensive due to its higher fixed cost associated with it. Return on investment is the main goal of any business organization, thus universities cannot be exempted here. However, researchers have found it does not always bring higher returns on investment (Ruiz-Alba et al., 2019). Further, the digital transformation process or the journey itself is complex and likely to be surrounded by uncertainties, need to fully understand the know-how of implementing innovative technologies, their advancement, and competitive benefits (Plekhanov and Netland, 2019). Thus, we emphasise the need of developing a SDT blueprint that guides the implementation of SDT systematically.

Although universities attempt to prioritize digital transformation as one of the strategic priorities, they face lots of difficulties in terms of how they can make the digital transformation strategy sustainable but not limited to (a) unavailability of sustainable policies to promote transformational strategies (b) absence of sustainable design/blueprint (c) non-existence of rational measures of digital sustainability and (d) not adopting the architectural changes/changes in the holistic design of architecture to gain sustainability. In this context, we constructively argue that universities significantly require sustainability labelling: Introducing sustainable digital transformation management approaches to influence values/practice of sustainability in the education sector, tools to stimulate sustainability from design, architecture, and implementation. Researchers stress the importance of adopting sustainable digital transformation policies, its transparency integrated as a key element of the digital transformation process (Otero et al., 2021).

Most of the report of DTS captures/is associated with the internal parameters of the organization Evangelista et al. (2014). The point here is that specifically in the global education industry, the outcome of sustainability needs to be dealt with the socio and economic variables (Seele and Lock, 2017). Thus, there is a critical need to focus on the integration aspect/element of integrating the internal elements of SDT with the external beneficial outcomes. Therefore, both qualitative and quantitative explorations are essentials to understand and examine the empirical linkage between the SDT and economic and social performance (proposition 6).

There is a lack of clarity in terms of how sustainable practices are practised, reported, and traced. Particularly there/reporting mechanism continues to unclear or very limited model/s exit to report. Thus, less enthusiasm for sustainability among DT practices. This paradox also limits the literature/reports on sustainable practices in DT. We also found that the usage of non-financial or non-economic or non-environmental practices/information are part of planning, limited in practice but the quality

of the information is not standardised to build sustainable practices. Sustainability as practice: Sustainability in digital transformation can be achieved through developing policies and procedures that are linked/extended to the various operational functions.

The unavailability of guidelines/policies on SDT has further widened the alignment of achieving sustainable goals as far as the universities are concerned. This paradox indicates that universities as the immune system of human society should become more accountable to sustainable digital transformation. It is also an interesting and deeper insight that the influence of post-modernism further extends the sustainability of digital transformation more complex with endless possibilities.

## 6.1 Challenges of adopting sustainability in digital transformation

In the digital age universities globally have been experiencing significant impactful changes in the digital transformation, which are greatly influenced by (a) Pressing sustainable practices (b) increasing investment in innovative technological advancement (c) rapid MACRO environmental changes (c) emerging social e-trends. As good as all other rapid changes, sustainable digital transformations require intense tuning/fine-tuning. The influential changes in the socio-technical-education system resulting from the knowledge economy have led to propelling sustainable digital transformation changes in the education industry but not limited to (a) Virtualization/ the use of cloud computing (b) Integration of Wi-Fi technologies (c) reduce e-waste (d) Build energy efficiencies and (e) Architectural weightage and new designs.

These forces in the realm of global education encourage collectively sustainability in the domain of digital transformation. Digital delivery of education (digital entrepreneurship) is viewed as one of the alternative mechanisms to fill the revenue/enrolment gap for universities (Rosin et al., 2020). However, digital entrepreneurship now demands/require organizational sustainable practices. Further, this domain is comparatively still in the embryonic stage and drastically varies in scope a lot particularly exploring the key benefits of sustainable digital transformation, and its entrepreneurial application from a global university's perspective (Hashim, Tlemsani and Matthews, 2021; Kutnjak, 2021).

## 7 Solutions

### 7.1 Radical sustainable digital transformation through an incremental approach

In many dimensions, globalized and digitalized education is distinctly different compared to services or industrial economies. One critical issue that needs addressing is the strategic gap, which is – the mismatch between the educational delivery model (business model) and the digital future (sustainable digital transformation), it is challenging but often great to fill the gap.

We propose a radical sustainable approach should be designed, developed, and implemented using an incremental approach to overcome SDT need/challenges. However, the radical sustainable approach requires the integration of (a) identification of SDT goals (b) development of digital policies (c) development of digital

measures (d) integration of technological capabilities (f) it is reporting mechanism. Thus, capturing these key elements and establishing a digital sustainable blueprint is the very first step of SDT, but the blueprint also should demonstrate the anticipated results/outcome in each stage. Decomposing the radical large-scale DT into a smaller scale enables the organization to selectively invest and experiment with many innovative ideas through piloting and scale approach (Li, 2019; 2020). As stated, the unique but holistic approach enables universities to nature and test run dynamically evolving innovative elements of digital transformation constantly while eradicating risks directly or indirectly associated with it,

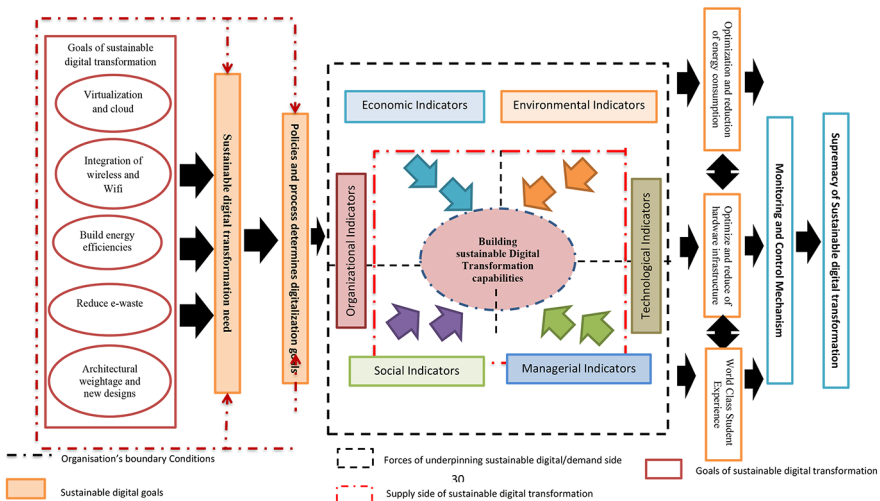
The incremental approach also provides a window of opportunity to filter and eradicate ineffective ideas before they get inherited into the DT blueprint and possibly cause any undesirable outcomes at the later stages. An incremental approach to SDT enables companies to avoid the “big-bang” approach, enable the organizational leaders to select an investment approach that best-fit the potential digital future, specifically, both the qualitative and the quantitative profits associated with it. In doing so, sustainable digital transformation is achieved via a series of incremental approaches (sprint/agile) but as a radical initiative (Li, 2020). From a larger perspective, there are four facets of SDTS (a) formulating innovative/technological driven business strategies (b) developing business model canvas (c) leads to organizational redesign/design and (d) integration of sustainable digital practice and its reporting. Gaining this process/position is viewed as building sustainable competitive advantage, but this transformational process is extremely challenged, often poses unique and greater contextual challenges.

As far as digital transformational leadership is concerned, the chief technical officer (CTO) is expected to lead the design, development, and implementation. It is viewed as IT leadership accountability. However, in the context of the universities, the chancellor (otherwise chief operating officer) and the dean (otherwise chief operating officer) are expected to collaboratively spear lead this initiative. The IT budget/resource allocation in the corporate/universities are in the diminishing margin; much of the budget is burnout on maintenance. It was found generally 80% of the budgets are spent in the corporate sector to maintain their infrastructure; 8–12% of the budget is spent only on the development of new IT initiatives, less than 10% of budget burnout occurs on building long term advantages. Thus, developing a DTS implementation from the stretch is a new strategic change that also may demand change management strategies (Li, 2019; 2020).

## 7.2 Higher education model to sustainable digital transformation

This theoretical model will help the key stake holder parties in terms setting the (a) strategic goals of sustainable digital transformation (b) design-develop policies which positively influence the practice of SDT and (c) enable the students to experience more holistic SDT experience (Fig. 10).

Particularly, the aims of the sustainable digital transformational experience attempts allow the students to undertake both cognitive and emotional educational learnings which require careful management and control process. The proposed theoretical model can also be utilized to gain insights into how distinct variables



**Fig. 10** Higher education model blue-print. Source (Mohamed Hashim, Tlemsani and Matthews, 2021; Du Toit and Verhoef, 2018; Bouza, 2019; Udovita, 2020; Riedl, 2020; Bican and Brem, 2020; Abad-Segura et al., 2020; Akhmetshin et al., 2020)

are connected to gain the importance of digital integration (integration points) for the effective delivery of online educational courses while promoting employee's engagement.

## 8 Conclusions

The academic evidence of the sustainability of digital transformation demonstrates that sustainability in digital transformation is a trend and interest which impacts the corporate reputation. Sustainable digital transformation creating more opportunities in various business areas such development of new sustainable policies, measures and their reporting mechanism, efficient power management, taking the cloud and its integration to the next level, introducing innovative recycle mechanisms, rationalizing the resource usage, demand for innovative architecture and importantly focuses on the continuous improvement of digital transformation practices.

The need for a sustainable blueprint is an absolute requirement adequate decision-making process in higher education and the future development of global education. We introduced an empirical higher education model for DTS, which is practical, simple, integrate the key elements of digital sustainability and can be developed as a management information system to penetrate sustainability in the digital eras. Sustainable practices in digital transformation are creating new opportunities mostly in the higher education sector. The practice of sustainable digital transformation and its continuity leads to successful SDT leadership in the education sector. In the globalization age, innovative and technology-driven systems are replied upon an interesting combination of hardware, networks, software and people; thus, a sustainable digital

transformation strategy must include all these disciplines (Venkatraman, 2005). In this context, we view that adoption of cloud computing technologies will lead the future of sustainable digital transformation process, because it diminishes hardware infrastructure to an optimum level, use power-efficient data centres and servers and ultimately leads to maximise the overall efficiency while reducing the cost involved.

The consulting giant McKinsey identified those organizations that have efficiently implemented the DTS have come high performing digital enterprises constantly producing monetary benefits. Those companies are able to gain superior digital enterprise performance by scoring in six building blocks, namely, (a) strategy and innovation, (b) process automation, (c) organization, technology, (d) data and analytics and (e) the customer decision journey (Canestrino et al., 2020). Utilizing these combinations of blocks to capitalize on the changing market conditions/need is viewed as the organization's capacity to desirably regulate the customer journey. We argue that one more block to be added with six block philosophy which is sustainability. As universities want to assimilate sustainable digital transformation into education, they need to acquire new skills, develop a business model, and introduce a new control mechanism. Thus, SDT is enhancing multi-dimensional growth (Laureti and Benedetti, 2019). As long as recyclable mechanism prevails e-waste can be viewed as a dependable and rare source of raw materials for reproducing innovative electronic/future hardware devices (Chmielarz, 2017). This process leads to less exploration of new raw materials (new intensive mining) also enable the natural resources last longer for future generation to come.

We project that the current evolvement of SDTS will lead to two distinct desirable outcomes (a) it will place sustainability as one of the centric priorities of digital transformation and (b) also it will produce considerable white colour job opportunities in the future, thus the economic shock. But also, will eradicate a large percentage of blue colour workers. We have reached the conclusion that one reliable way to resolve this is to increase the awareness of the strategic importance of adopting sustainability to digital transformation through the educational course at the university level. Also, consistent development niche domain sustainable digital transformation should be scaled as wisdom. This approach also would create more opportunities for people. If universities have strong policies, skillset, models and reporting mechanisms to promote sustainable practices from the design level, they can increase the surplus output of DT by reducing the usage of power energy, maximising the usage of wireless, increase the usage of cloud computing while reducing the investment in physical IT infrastructure, this approach leads to high profitability, reducing operation cost and most importantly becomes accountable for sustainability of digital transformation/education.

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