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Introduction: The crisis of African Studies and Philosophy in the epoch of The Fourth Industrial Revolution

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Abstract

The very claim of the historical instance of the Fourth Industrial Revolution (4IR) is increasingly being subjected to critical interrogation from a variety of cultural and ideological perspectives. From an Afrocentric theory of history, this questioning of the ontology of the 4IR is sharpened by Africa's experience of the claimed progressive mutation of global industrial progress from the "first" to this "fourth" revolution. Africa experienced the first industrial revolution as a European revolution in the exploitation of her natural and human resources, as well as the despoliation of her cultural-epistemic sovereignty. The challenge to fully engage in the theorisation of this 4IR, given the overwhelming and inexorable effects of its digital technologies on the personhood, sociality and geopolitical state of Africa has exposed the critical need for a set of rigorous Africanist analytical tools and epistemological approaches capable of guiding Africa's appropriation of this techno-social revolution. This essay introduces the collection of research papers that have been selected for their endeavour to meet this challenge. It is highlighted that all of them move from a unique approach that asserts that technological progress is historical-cultural and socially embedded. Some of them address the question of the historico-ontological status of the 4IR innovatively with original African methodological tools, while others demonstrate how an African epistemology can be applied to issues such a digital virtual communities and robotics. This contribution to the bourgeoning field of African Philosophy of Technology is admired as work in progress.

Keywords: 4IR; African Studies; African history; African philosophy; social robotics

Introduction

An industrial revolution is both a technological and social phenomenon that is framed through time markers. Its impact draws and designates an epoch. It implies a radical change at a global scale in the collective productive forces of a generation, whereby such scientific and technological advances, in turn, effect significant changes in social relations and the quality of the lives of individual members of society. The papers in this special thematic issue have

perspicaciously subjected the Fourth Industrial Revolution (4IR) to the foregoing broader definition of an industrial revolution from a variety of Africanist methodological perspectives. A timely overarching question being grappled with is: Can this global spread and routinisation of digitalisation as a way-of-life that our generation is experiencing be comprehended, appropriated and contextualised through the indigenous intellectual tools? Alas, then the reality had to be confronted that when thinking of epistemological tools and perspectives, "African Studies and philosophy" is in what can justifiably be described as a state of a protracted ontological crisis (see ZALENZA 1997; HOUNTONDJI 2009).

This crisis has historically presented itself as an esoteric intellectual agony about the nature, status, geo-locality and role of African Studies, which incorporates African philosophy, in the contemporary world (see ZELEZA 1997). The debates and controversies ignited by and around the works of Mahmood Mamdani (1998), Archie Mafeje (2000), Achille Mbembe (2002) and Paulin Hountondji (1990), to name a few, have highlighted the fact that there is no single and straightforward way of studying social phenomena or objects in "the African Way".

In tackling the phenomenon of the 4IR from the prism of this crisis of African Studies and philosophy, it is noted that the disciplinary domain of History — more specifically, protestations and theorisations around historiography — is one[1] of the most debated subjects within the field of African Studies (see CURTIN 1995; ZELEZA 1997, 88-197). Understood from a philosophical perspective, this fascination with "the historical" is a reflection of how the lived-being of the present African is tied with the past episodes of orchestrated cultural epistemicide, the Trans-Atlantic Slave Trade, colonisation, apartheid racism as well as the struggles against all of these. History, and anything "historical", is to an enlightened African's psyche traumatic. For this reason, it should be no wonder that an adumbration of a fourth industrial revolution that invokes ties to some precedent "first", "second" or "third" revolutions should, from an Africanist perspective, provoke a metahistorical inquiry on the conceptual ontology of the so-named Fourth Industrial Revolution. The questions, "what exactly is this fourth industrial revolution, and what does it mean in terms of Africa's self-knowledge?" are implicit in nearly all the contributions in this collection.

[1] The other prominent arena being the discourses around Anthropology.

Tshilidzi Marwala, arguably the leading African theoretician on the institutionalisation of The Fourth Industrial Revolution[2] famously views the latter as "the current that blurs the lines between the physical, digital, and biological spheres through AI, automation, biotechnology, nanotechnology and communication technologies" (MARWALA 2020a). In his latest ambitious endeavour *Closing the gap: The Fourth Industrial Revolution in Africa* (MARWALA 2020b) he opines on a wide range of issues in which he essentially advocates for the speedy embrace by Africa of what he roundly perceives to be the benefits of the 4IR technological process. Contrary to Marwala's largely uncritical and ahistorical[3] characterisation of the 4IR, there is a growing body of literature in Africa and her diaspora that emphasises the embeddedness of technology in social relations and cultural practices (see BARTON 2020; BIRHANE 2020; LAMOLA 2021c; NGWANE and TSHOAEDI 2021). The authors of the papers in this special issue extend this body of a critical African discourse on technology.

A historicist African perspective observes the 4IR as an avalanche of technology-driven human-ontological transformations and sociological changes that are catalysed by globalisation, and the latter's promotion by a neoliberalist globalism. In the functioning of globalism as an ideology of Westernism, as Manfred Sterger reminds, are social forces and a grand narrative that "seek to endow this concept [globalisation] with norms, values, and meanings that not only legitimate and advance specific power interests but also shape the personal and collective identities of billions of people" (STEGER 2009: vii). Aptly, Marwala exudes that 4IR "requires a convergence of humans and technology" (2020b, 146), which begs the question: with whose technologies are Africans converging?

As the world coagulates into rival geo-technological superpowers, and the much-vaunted one-world dream is increasingly threatened, we are being told that there is neither West nor East from which an alien wave of technological benevolence for human progress is inexorably flowing. There is just an upsurge of global wizardry that is innovatively disrupting all previous models of the role and modes of technology in society. There are universalistic

[2] In my narration, I have treated the preceding industrial revolutions without capitalising them as nouns, denoting them, instead as incidentally connected socio-historical phenomena that emanated in Britain around the late 1700's. On the contrary I write The Fourth Industrial Revolution (4IR) in a manner that captures the conceptual import of its meaning and manifestation. I contend that the 4IR is a self-serving Narrative. Whilst I agree with Ian Moll (2021) that it serves as an ideology, I disagree with his view that the fourth industrial revolution is yet to exist.

[3] See for example, Marwala's normless summation of the impact of the British imperialist first industrial revolution on the colonisation of South Africa (Marwala 2020b, 6).

new ways of living, shopping and relating to others that one has to adopt and adapt to in order to survive in this emergent digitalised social formation. Even the African who could not be dragged into the era of reliable electricity supply, can now, in the 4IR, just be swamped and automatically be reconfigured by artificial intelligence technologies into the futuristic post-human (LAMOLA 2021a).

A historical perspective, wherein "the historical" implies the consideration of the social and economic factors, would insist that the Africa of today is largely the product of the first industrial revolution as it sprouted from Great (!?) Britain. The innovation in steam power energy, mechanisation and largescale industrial production during the late 1700s spurred the requirement for raw materials and cheap labour, leading to the predatory discovery of Africa as the ample source of the latter two economic inputs (see BYTHELL 1983). Having been denuded of their humanity, and their human capital degraded by exploitation suffered in service of the first industrial revolution, Africans could neither be significant participants nor beneficiaries of the second and third industrial revolutions. Being thus primordially handicapped during the first industrial revolution, what chance do they have in the so-called Fourth Industrial Revolution?

Emblematic of the disempowerment of Africa is the fact that even though the second industrial revolution manifested during the late 1800s and early 1900s with the discovery of electricity and mass factory productions enabled by electrification, Africa still continues to be a dark continent. Sub-Saharan Africa accounts for 75% of the world's population without access to electricity[4]. Twenty of the least electrified countries in the world are in this region. South Sudan with only 7% of the households electrified, is the least electrified country in the world (BLIMPO and COSGROVE-DAVIES 2019). The paucity of electricity as the infrastructural platform of the third industrial revolution, upon which the proclaimed Fourth Industrial Revolution is emerging, has spawned an established critical narrative of "the digital divide".

On the other hand, Africa's human capital and wealth of natural resources continue to be exploited for the benefit of Western and Eastern imperialist capitalism, well into the twenty-first century. Whilst some of the key "tech-minerals", such as Tantalum required for the production of mobile phones and computers, are exclusively found in a country such as the Democratic Republic of Congo, the benefits of the age of the computer remain out of reach of a significant number of African countries and communities.

[4] See https://www.brookings.edu/blog/africa-in-focus/2021/06/18/figure-of-the-week-increasing-access-to-electricity-in-sub-saharan-africa/

These developments, real and retrospectively theorised, find African philosophy and scholarship in African social sciences in a state of crisis. At a critical cultural-philosophical level, we have the challenge of persistent colonialism with its multidimensional manifestations that range from the epistemic to the economic spheres, where the latter continue to dictate that the flow of knowledge production will be from the West to Africa. One of the largest and most vibrant African Studies Associations in the world is in the USA, a country with an academy still fraught with the challenges of antiblack racism and patriarchy. How do we put an anti-colonial or decolonial prism on the geopolitical hegemonisation of these digital technologies while we are still embroiled in debates about who should be the legitimate articulators of the plight and aspirations of Africa? How do we decolonise academic neo-colonialism? With the 4IR upon us, we are now into an intellectual terrain where we must grapple with algorithmic colonisation and imperialist cultural technogenesis. Do we have a theoretical or analytic framework to deal with these intellectual challenges?

At the same time, the dramatic scale of the ramifications of the technologies of the 4IR, on personal, social and geo-national levels, do of course demand more than just the crafting of an epistemological or methodological approach, they demand some form of a position. Unfortunately, or as it should be, there is no position for Africa as a geo-cultural circuity or a geo-polity to take. The luxury of the actions of the Luddites who in the 1800s acted against the manner in which mechanisation wrought by the first industrial revolution was distorting the nature of work, destroying jobs, by resorting to attacking factories and burning machines, is not feasible in the current 4IR epoch. Equally, the African intelligentsia cannot settle for the command to uncritically "embrace the Fourth Industrial Revolution".

Africa is being engulfed by digitalisation. Cheap telecommunication devises and the growing success of service providers on the Wifi-hungry continent are ensuring that Africans survive on Facebook. The ability to purchase "data" competes with that of buying bread. Africans, aka dwellers of sub-Saharan Africa, are in the fourth industrial revolution; they will not escape the effect of Mark Zuckerbeck's recreation of the *universe* as we know it through Facebook, into the *metaverse*[5]. We are in a technogenetic phase of human evolution; powerful, commercially-enthused forces are remaking us according to technology (Lamola 2021b). The extant challenge is developing theoretical tools and crafting thematic prisms that will scientifically analyse and progressively problematise this sociohistorical epoch.

[5] See https://www.newyorker.com/culture/infinite-scroll/we-already-live-in-facebooks-metaverse

The Essays in this Special Issue

Taking on this challenge for a search for Africa-centered theoretical tools and thematic prisms that will enrich African intellection during the current era, a pioneering international roundtable conference was convened at the University of Johannesburg in December 2020 by the Research Group on Africa, Philosophy and Digital Technologies (APDiT). The working theme was *African Studies and the Fourth Industrial Revolution: In Search of an appropriate analytic framework*. As the second stage of the inquiry, a call was made for research papers for publication in what became this special issue of [Filosofia Theoretica]. Therefore, the papers in this collection lay the ground of the study of the 4R from the perspective of an African historical experience in a format that is akin to a symposium. They add to a growing literature on contemporary African philosophy of technology that is rigorously interrogating the relationship between technology and society in Africa.

Unique to this special issue is that that the historical ontology of "the Fourth Industrial Revolution" is sharply problematised in a uniquely African way. The first four papers (Kasozi; Oyekunle; Ezeogu; Oduor) question the treatment of the 4IR as a novel nomenclature that has no relation to history. Their disputations resonate with emerging critical literature in this regard, such as Ian Moll's "The Myth of the Fourth Industrial Revolution" (MOLL 2021) in which Moll argues that "a 4IR is not yet with us" (MOLL 2021, 2). Moll had explicated that "an industrial revolution encompasses a complex mutually generative range of economic, social and political transformations" (ibid.). According to him, such a mutually-generative case-effect dynamic is only observed in respect of the preceding First, Second and Third, but not with the Fourth industrial revolution.

Incidentally, Moll's argument coheres with Ferdinand Mutaawe Kasozi's brilliant Africanist contention in the first of our papers. Kasozi's disquisition is derived from his utilization of a unique African epistemological prism of a system he has developed and named Ntu'ology. Taking the theoretical pillars of his ontological system of Ntu'ology as a causative system, he evaluates and asks as to whether the claim of the existence of the 4IR fulfils these causative links. His paper "Ntu'ologico-agnostic Reflections on the Fourth Industrial Revolution Premise" concludes that whilst the preceding three industrial revolutions are consistent with the evaluative heuristic of his system, he is led to an agnostic position as far as the 4IR is concerned: "the Fourth Industrial Revolution may exist, but we cannot prove this with theoretical reason" he finds. Kasozi's paper is a classic example of how an indigenous Afro-centric theoretical system could be applied to a socio-technological complexity, and be utilised to formulate a scientific-intellectual positionality.

Going beyond the traditional instance of the application of indigenous knowledge systems (IKS) as the basis of an African methodological approach on all matters and subjects African, Akinpelu Oyekunle in the second paper offers pertinent contribution of what he calls a “process formation" framework as contrast to “the content formation” one. Proposing this process formation methodological framework as preferable to the particularist and localised view of IKS. He elaborates process formation as a way of knowing within a particular cultural context, without compromising the applicability of what is known beyond local context. He extolls this a means of removing “the toga of esoteric nature” that often characterises IKS. We are thus offered a tool for crafting an African philosophy of technology that can robustly engage in and contribute to cross-cultural dialogue during the fourth industrial revolution.

Juxtaposed against the usual criticisms of defective IKS, or lack of any IKS approach in the way Africa grapples with twenty-first-century socio-technological developments, is the vexed discourse around the geopolitics and economics of the production of technology. Uchenna Ezeogu enters this terrain with a specific concern on the implications of these geopolitics on the dynamics of knowledge production. Hitching onto the “history” motif I referred to earlier, he takes as his point of departure Francis Fukuyama’s analysis of the forces that are reputedly at work in human history, “the logic of modern science” and the ‘the struggle for recognition”. Ezeogu unveils the Eurocentrism of this view of these forces as they have marginalised Africa’s participation, and failed to recognise her place in “the global space”. He remonstrates that “in the era of the Fourth Industrial Revolution, it will be antithetical for Africa to continue to adopt or consume technologies driven by Eurocentrism without projecting its contribution to the global space”.

The paper following Ezeogu is by Reginald M. J Oduor. Oduor zeroes on the normative imperative of inclusivity and accessibility in the design and distribution of modern technological applications. It is a remarkable privilege to have this contribution from Oduor, who actively uses technology in his teaching, research and publication programme even though he is substantially visually-impaired. Besides highlighting the need for inclusiveness, he posits one of the most systemic and fresh introductions of the Fourth Industrial Revolution. The originality in his argument lies in his alert that stems from his linkage of how technology can influence and determine cultural identity. The immense ramification of the technological process on African self-knowledge is here well illuminated. Of the four normative considerations (inclusiveness, affordability, cultural identity, and ethical orientation) to guide the initiatives of African societies in their deployment of the technologies of the 4IR, “respect for cultural identity to guard against cultural imperialism” stands out.

Continuing on the trail for the search of the most appropriate Africanist methodological approach to the study of the 4IR, Turner n.d.n (Turner, Lamoureaux and Merron) propose the radical epistemic posture of "Indiscipline". Their paper deconstructs the discourse on a search for a formal methodology for the account and dissection of the intersection of the Fourth Industrial Revolution and African Studies. They introduce and demonstrate their notion of "indiscipline" through the positing of the Square Kilometre Array radio telescope project (SKA) based in South Africa as a case study. From thence, they turn on the recent experience of the innovative response of science to the Covid-19. They implicitly ask why the same freedom to break the bounds of disciplines cannot be allowed in Africa's own appropriation of the 4IR.

The last of the two papers are demonstrations of discursive innovation of applying Africanist intellectual lenses on social phenomena and technological artefacts and platforms of the 4IR. Beatrice Okyere-Manu and Stephen N. Morgan turn the table on the standard ethical discomfort with the virtuality instanced by social media platforms. Instead of seeing this as a threat to the sociality of traditional African communities, they ask a progressive question: how do we ensure that digital virtual communities become a true community qua community? They address this question by proposing and arguing for a "virtual communitarianism"— an online community that integrates essential features of traditional African communitarianism in its outlook and practice. Such an Africanised digital communitarianism, Okyere-Manu and Morgan argue, can make for a strong ethical virtual community where members can demonstrate a strong sense of group solidarity, care and compassion towards each other.

In a similar demonstrative fashion, Catherine Botha takes on the reality of social robotics. She alerts of the social and cultural biases which are implicit in the design of humanoid robots, and the implications of these on race and gender discourses. Adopting a feminist perspective, she focuses on the somaeasthetic of robotic designs, that is, how the human body is allowed its self-representational expression in robots. Botha explicates the concept of "somaeasthetics" and contends that a somaesthetics of robotics is needed to reveal how gender bias is materialised in the machine. This is a subject of great importance for African persons with black bodies, especially for African women, where the sex robots industry is routinely exploiting the somaesthetic expression of the woman body.

Conclusion

The crisis of African studies, wherein by the latter, I denote a broad range of discursive enterprises that are seized with research, study and advocacy of anything that has to do with Africa and her people, has framed this project. What motivated the papers that have been written and presented here, and the engagement of the peer-reviewers who so generously invested their time with

us, is the challenge of the overwhelming effects of the 4IR on the social and personal ontologies of Africans. African intellectuals are repairing their epistemological boat in the middle of a raging sea of breath-taking socio-technological currents. Thus, the provocations and propositions in this issue can only be a work in progress. *Aluta continua*!

Relevant Literature

1. BARTON, C. J. "The Fourth Industrial Revolution: Promise or Peril?" [IEEE International Symposium on Technology and Society (ISTAS)], pp. 302–309, 2020. https://doi.org/10.1109/ISTAS50296.2020.9462215
2. BLIMPO, M.P & MALCOLM COSGROVE-DAVIES. [Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact] 2019. Washington, DC: World Bank.
3. BIRHANE, B. "Algorithmic Colonization of Africa" [SCRIPT-ed], 17(2), pp. 389-409, 2020.
4. BYTHEL, D. "Cottage Industry and the Factory System" [History Today] 33(4), pp.17-23, 1983
5. CURTIN, P. "Ghettoizing African History". [ACAS Bulletin: Special issue on the ghettoizing debate: Africa, Africans and African Studies]. Issue No. 46, 1995 http://acas.prairienet.org/bulletin/bull46toc.html, Accessed 2021-10-17
6. HOUNTONDJI, P.J. "Scientific Dependence in Africa Today." [Research in African Literatures] 21 (3), pp.5–15, 1990.
7. ____. "Knowledge of Africa, Knowledge by Africans: Two Perspectives on African Studies" [RCCS Annual Review: An online Journal for the Social Sciences and the Humanities]. Issue No.1, 2009, http://www.ces.uc.pt/publicacoes/annualreview/, Accessed 2021-07-06.
8. LAMOLA, M.J. "The future of Artificial Intelligence, posthumanism and the inflection of Pixley Isaka Seme's African humanism" [AI & Society: Journal of Knowledge, Culture and Communication] https://doi.org/10.1007/s00146-021-01191-3, 2021a
9. ____. "Covid-19, Philosophy and the leap towards technological posthuman" [Phronimon], Vol. 21. https://doi.org/10.25159/2413-3086/8581, 2021b.
10. ____. "Africa in the Fourth Industrial Revolution: A status quaestionis, from the cultural to the phenomenological", In: *African Values, Ethics, and Technology*, edited by Beatrice D. Okyere-Manu, pp. 35-52, 2021c .Cham: Palgrave Macmillan

11. MAFEJE A. “Africanity: A combative Ontology” [CODESRIA Bulletin], Issue 1, pp. 66-71, 2000.

12. MAMDANI, M. “Teaching Africa at the Post-Apartheid University of Cape Town: A Critical View of the ‘Introduction to Africa’ Core Course in the Social Science and Humanities Faculty’s Foundation Semester, 1998”. [Social Dynamics] 24 (2), pp.1-32, 1998.
13. MARWALA, T. “Covid-19 Has Forced Us into the Fast Lane of the 4IR Super-Highway” [Daily Maverick], 28 May, 2020a https://www.dailymaverick.co.za/opinionista/2020-05-28-covid-19-has-forced-us-into-the-fast-lane-of-the-4irsuper-highway/
14. ____. 2020b. [Closing the gap: The Fourth Industrial Revolution in Africa]. Pan Macmillan: Johannesburg:
15. MBEMBE, A. “African modes of self-writing” [Public Culture] 14(1), pp.
239-273, 2002
16. MOLL, A. “The Myth of the Fourth Industrial Revolution” [Theoria], 68 (167) , No. 2, pp. 1-38, 2021.
17. NGWANE, T.; TSHOAEDI, M. eds. [The Fourth industrial Revolution: A Sociological Critique] Jacana: Johannesburg, 2021
18. STEGER, M. [*Globalism: The new market ideology*] Rowman & Littlefield: Lanman, 2009.
19. VERBEEK P-P. “Artifacts and attachment: a post-script philosophy of mediation [Harbers H. ed. Inside the Politics of Technology: Agency and normativity in the co-production of technology and society] pp. 125-146. Amsterdam: Amsterdam University Press, 2005
20. ZELEZA, P.T. [Manufacturing African Studies and crises] CODESRIA: Dakar, Senegal, 1997

Ntu'ologico-Agnostic Reflections on the Fourth Industrial Revolution Premise

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Abstract
This paper proposes an *ntu'ologically* analytical questioning of the contentious Fourth Industrial Revolution phenomenon, as it suggests that an industrial revolution ought to be appreciated in causation or causality terms. The cause of an industrial revolution is required to comprise 'adequacy quality causing interactions' among entities of specific *ntu* categories. These interactions bring into being nine basic *ntu'ological* adequacy qualities or industrial revolution criteria. For that reason, nine selected modes of interaction, called in this paper, *ntu'ological* interactions forms, guide the analytical questioning of the possible existence of a Fourth Industrial Revolution. The aforementioned nine criteria are incontestable in respect of the First, Second and Third Industrial Revolutions. This paper, however, takes the agnostic position that: the Fourth Industrial Revolution may exist, but we cannot prove this with theoretical reason.

Keywords:
Fourth Industrial Revolution (4IR), Third Industrial Revolution (3IR), Second Industrial Revolution (2IR), First Industrial Revolution (1IR), Ntu, Ntu'ology, Agnostic position.

Introduction

This paper bears a heading that encloses a relatively new word in scholarship, namely: the term *ntu'ology. Ntu'ology* is coined here and used to refer to a study, discourse, reasoning or discussion concerning Bantu wisdom, especially the wisdom of Eastern Bantu (KASOZI 2000; KASOZI 2010). I regard *ntu'ology* to be an ultimate principle for classifying reality and values according to what I now call 'the seven *ntu* categories'; originally, I had compressed them into four *ntu* categories. The seven *ntu* categories are: *muntu, kintu, wantu, ddi, kantu, supra-ntu and meta-ntu* categories.

The entities in *ntu'ology*'s *muntu* category are exclusively human beings, and the branch of ntu'ology that investigates these entities is what I term *muntu'ology.* Non-human, material beings are the entities that constitute the *kintu* category and are examined by a sub-division of *ntu'ology* called *kintu'ology.* Whilst space, the only entity of the *wantu* category is studied under the *wantu'ology* branch of *ntu'ology,* matters of time, periods and

temporal circumstances are investigated by the *ntu'ology* branch, which deals with *ddi* category entities and is named *ddi'ology*. Non-human, non-material beings are the entities that create the *supra-ntu* category and are examined by a subordinate division of *ntu'ology* called *mpewo'ology.* The *meta-ntu* category of *ntu'ology* consists solely of the Supreme being whose reality is studied by *ssentu-ology.*

In my view, the seven *"ntu"* categories present a synoptic view of what I consider to be the salient features of the foundations of multiple Bantu philosophical and religious traditions, traditions which encompass rules and beliefs that guide Africans called Bantu in their day-to-day judgments, decision-making and other private and public life processes. For that reason, the seven *"ntu"* categories form the theoretical framework for a discussion on pertinent matters in this paper.

The title of this paper presents as well another key phrase, namely: "Fourth Industrial Revolution". This phrase forms the core of the problem that I aim to address here. On the one hand, common parlance and scholarly works, such as the academic presentations of Schwab (2016), McGinnis (2018) and Marwala (2020), introduce us to a conversation on the theme of the Fourth Industrial Revolution. Such talk is oftentimes grounded upon and facilitated by the past existence of a First Industrial Revolution in the 18th Century, a Second Industrial Revolution in the 19th Century, and, in the 20th Century the reality of a Third Industrial Revolution. In my view, nevertheless, the possible existence of a "Fourth Industrial Revolution" is questionable.

On the other hand, scholarly prudence dictates that prior to confirming the reality of a "Fourth Industrial Revolution", we ought to initiate the critical task of subjecting the possible existence of such a revolution to a procedure of what I call an "IR adequacy analysis". Subjecting the possible existence of the "Fourth Industrial Revolution" to an adequacy analysis means, measuring the characteristic features of that epoch against the contents of a set catalogue of essential elements in order to determine whether or not that period's naming fulfils the requirements for deserving the label "industrial revolution".

Consequently, before subjecting the questionably labeled fourth industrial revolution (4IR) to an adequacy analytical procedure, we should talk about the "Fourth Industrial Revolution Premise". The existence of that embryonic industrial revolution is, in my view, a premise, since we can so far either act agnostically or simply cautiously assume a commencement of another industrial revolution that is clearly distinguishable from the perceptibly acknowledged Third Industrial Revolution.

***Ntu'ology*'s Agnostic Role: Questioning The 4IR Existence**

For the previously given reasons regarding the need for an adequacy analysis vis-à-vis the possible existence of a 4IR, this paper resorts to *ntu'ology* in analysing the 'existence hypothesis', which concerns an industrial revolution that could be following the Third Industrial Revolution. Specifically, this

inquiry embraces, from the perspective of selected *ntu* categories, an account of possible causes of the 4IR in order to enlighten us on what the 4IR could be intended to be. In so doing, I exhibit *ntu'ology* as an African system of thought that can play the formal causality role of questioning whether the current understanding, form, pattern, etc., of what is called the 4IR verify the existence of an industrial revolution.

Considered in the *ntu'ological* perspective, an industrial revolution ought to be appreciated in causation or causality terms. That is, on the side of the cause, there must be what I regard as 'IR adequacy quality causing interactions' among entities of specific *ntu* categories. On the side of the effect, it is required to have what I term an '*ntu'ological* adequacy quality', which results from the previously described cause.

Further, to have an industrial revolution, IR-adequacy-quality-causing interactions ought to transpire among entities of specific ntu categories that characteristically play a fundamental role in letting a period of time with its set of transformations meet the Industrial Revolution criteria. The strategic *ntu* category entities here in the discussion are as follows:

i. *"Ddi"* category entities that facilitate the periodisation of a social-economic transformation and its qualification as an Industrial Revolution;

ii. Entities of the *"muntu"* category which as a whole construct the fundamental human factor in the structuring of an Industrial Revolution;

iii. *"Kintu"* category entities or non-human, material things that contribute essentially to the rise of a social-economic transformation deserving the title of an *Industrial Revolution*;

iv. Entities of the *"kantu"* category which constitute a variety of particular modes of the existence of humans and other beings, modes of existence that are part and parcel of specific Industrial Revolution criteria; and

v. *"Wantu"* category entities that define the global nature or geographical extent of a social-economic transformation to be called an *Industrial Revolution*.

In my view, it is out of the interactions that occur among these strategic entities that *ntu'ological* adequacy qualities emerge and formulate Industrial Revolution criteria. In other words, Industrial Revolution criteria, seen from an *ntu'ological* viewpoint, are effects of interactions among entities of specific *ntu* categories. For that reason, nine selected modes of interaction, called in this paper, *ntu'ological interactions forms*, will guide our analysis and questioning of the possible existence of a 4IR.

The first *ntu'ological interactions form* concerns the social-economic connections among entities of the *ddi, muntu, kintu, kantu,* and *wantu* categories. The cohesion among these entities is a cause of an *ntu'ological* Industrial Revolution adequacy quality since that cohesion happens in such a manner that the following Industrial Revolution criterion is produced as a result. Thus, the interactions give rise to fundamentally new or radical technological innovation rather than an expedited progression of the technologies of the existing development stage.

For an example, we consider an interface among entities of the *ddi, muntu, kintu, kantu* and *wantu* categories during the 1760 – 1840 period (TOYNBEE 1884); that is, during the times of what historians regard as the archetypal industrial revolution or the First Industrial Revolution (STEARNS 2012). A general portrayal of the interactions here in discussion is as follows:

a) The period under consideration here comprises the First Industrial Revolution times (*ddi* category entities);
b) *Factory-owners* (*muntu* category beings) played a key role during that epoch;
c) These were consequently the owners of *factory machines* (*kintu* category entities);
d) The machines were operated by exploited *factory laborers* (*muntu* category beings);
e) These laborers denounced in vain the *degradation of their working class* (*kantu* category reality);
f) They also abhorred their *appalling working and living conditions* (*kantu* category realities) in the *crowded cities and large factories* where they lived and worked (*wantu* category entities).

A second example about the first *ntu'ological interactions form* may be drawn from the subsequent synoptic view of the emerging of the First Industrial Revolution. Greenwood (1999) proposes that the English industrial transformation, which in my view provides the core framework of an industrial revolution "required hundreds of inventors, thousands of innovating entrepreneurs, and tens of thousands of mechanics, technicians, and dexterous rank and file workers" (1999, 8). From this synopsis, we draw an outline of selected examples of entities of the *ddi, muntu, kintu, kantu* and *wantu* categories whose interactions gave rise to the respective transformation; thus:

1. *"Ddi"* category entities: the individual and general temporal contents of the First Industrial Revolution period of time;
2. Entities of the *"muntu"* category: the inventors, entrepreneurs, mechanics, technicians and workers;
3. *"Kintu"* category entities: factory machines, engines and other material equipment;

4. Entities of the *"kantu"* category: the widespread and yet related nature of innovations; and
5. "*Wantu"* category entities: factories where all that happened; and, in general, the English geographical area where the industrial transformation was taking place.

During the 1760 – 1840 period of time, therefore, interactions among the aforementioned entities of *ntu* categories facilitated the English industrial transformation to such an extent that the British economy as a whole switched "from manual techniques to mechanised production" (GREENWOOD 1999, 8). Greenwood's summary underscores the thesis of the first *ntu'ological* Industrial Revolution adequacy quality. That is, in the case of the First Industrial Revolution, the interactions, here in discussion, gave rise to fundamentally new or radical technological innovation rather than an expedited progression of the technologies of the then existing development stage of the English world.

Subsequently, the first *ntu'ological* Industrial Revolution adequacy quality leads us to this 4IR-possible-existence question: in respect of global localities where the 4IR is said to have set off, is it possible to prove with theoretical reason the existence of special forms of interaction among entities of the *muntu, kintu, kantu,* and *wantu* categories? That is to say, interactions that are causing a fundamentally new or radical technological innovation, which is dissimilar to an expedited progression of the technologies of the Third Industrial Revolution. Since this question lacks direct responses, I am obliged to state that: the 4IR may have started, but, we cannot prove this using theoretical reason.

The second *ntu'ological interactions form*, too, concerns social-economic connections among entities of the *ddi, muntu, kintu, kantu,* and *wantu* categories. The interactions among these entities construct, as well, a cause of an *ntu'ological* Industrial Revolution adequacy quality. Nevertheless, the form of cohesion, in this case, occurs in such a manner that a different adequacy quality or Industrial Revolution criterion is produced as a result; namely: the interactions among those entities bring into being an internal metamorphosis in specific entities of *muntu* and *kintu* categories combined with new ground-breaking types of cohesion between given ntu category entities

To throw more light on the foregoing *ntu'ological* Industrial Revolution adequacy quality, we may take the typical factory work processes of the 1IR, for an example. Thus, the subsequent outline of the adequacy-quality-causing connections among the respective entities:

i. Kennedy (1993) portrays as appalling the labor processes that typify factory work during the *1IR times [ddi* category entities];

ii. The ownership of the *factory machines* rested with the *private capitalists* [*kintu and muntu* category beings] (BYTHELL 1983, 17-18);
iii. The buildings which housed the factory machines also belonged to the *private capitalists* [*wantu* and *muntu* category beings] (BYTHELL 1983, 17-18); but
iv. The major contributors to the labor processes were, nonetheless, the *property-less, wage-earning employees* [*muntu* category beings] (BYTHELL 1983, 17-18).

In my opinion, the metamorphosis or foremost social transformation that resulted from the interactions among those entities comprised the loss of human autonomy in the work process, where the employees were much less like the factory machines they operated. Additionally, there was the formation of the working class (THOMPSON 1963, 194). The emergence of the working class brought with it new ground-breaking types of cohesion between this class and the class of property-owners or the capitalists. For instance, the working class was not only contrasted but also hostile to the capitalist class (MARX & ENGELS 1848, 14-15).

The foregoing reflections on the second *ntu'ological* Industrial Revolution adequacy quality urge me to put forward this 4IR-possible-existence question: Can we prove using theoretical reason that somewhere in the universe we may come across 4IR instances of special interaction among entities of the *ddi, muntu, kintu, kantu,* and *wantu* categories that bring into being that sort of internal metamorphosis in specific entities of *muntu* and *kintu* categories, a metamorphosis that is directly linkable to new ground-breaking types of relations between given *ntu* category entities? And; if such 4IR instances of special interaction among these categories exist somewhere, what are new ground-breaking types of relations between those entities? Accordingly, it is my considered opinion that: whereas the 4IR could be upon us, we lack sufficient theoretical rationale to verify its existence.

The third *ntu'ological interactions form* considers a further variety of relations among entities of the *ddi, muntu, kintu, kantu,* and *wantu* categories. An *ntu'ological* Industrial Revolution adequacy quality is born out of those relations, given that those exchanges happen in such a way that the following Industrial Revolution criterion is produced as a result. That is, the respective *ntu'ological* interactions generate rapid advancement in human beings' skills, knowledge, expertise and legerdemain coupled with a corresponding transformative mode of existence in non-human, physical beings, e.g. equipment, machinery and tools.

We may draw instances from the 2IR in order to make this Industrial Revolution adequacy quality clearer. Mokyr (1998) writes about the rapid progression in skills, knowledge, expertise and legerdemain in the 2IR thus: "the great pathbreaking inventions ... were crucial ... because they increased

the effectiveness of micro-inventive activity" (1998, 1). The 2IR-adequacy-quality-causing interactions among the respective *ntu* categories entities which underlay the rapid progression here in discussion may be summarized as follows:

a) The great pathbreaking inventions that Mokyr (1998, 1) writes about took place during the *years of the 2IR* or the *1865-1914 period of time* ("*ddi"* category entities);

b) Obviously, there were *human resources* behind the great inventions, who included *inventors, entrepreneurs, mechanics, technicians, supervisors, workers* and so on (entities of the *"muntu"* category);

c) The *"kintu"* category entities implicated in this matter of the pathbreaking inventions include: *open-hearth furnaces, motor cars, ships, aeroplanes, radio signals, internal combustion engines, diesel engine-powered machines, plastic material,* and so on;

d) The implementation of Fredrick Taylor's (1911) sets of novel proposals about reorganizing factory workers in the United States of America and in the Soviet Union (SCOVILLE 2001) provide a background to appreciating *transformation modes* of the labor process, work relations in the workplace and even community and social relations during the 2IR (entities of the *"kantu"* category); and

e) Hobsbawn (1989, 62) writes about the results of the great inventions of 2IR that led to the creation of a single *global* economy and the linking of *countries of the world* with each other (*"Wantu"* category entities).

The preceding reflections on the third ntu'ological Industrial Revolution adequacy quality prove the following ntu'ologico-agnostic 41R-possible-existence question: Can we provide adequate theoretical reasons to substantiate the existence of 4IR interactions among entities in the *ddi, muntu, kintu* and *kantu* categories, interactions that are globally causing rapid advancement in human beings' skills, knowledge, expertise and legerdemain to which we might relate corresponding 4IR transformative mode of existence in non-human, physical beings (e.g. equipment, machinery and tools)? On the one hand, the reality of such interactions and their effects would either proclaim the onset of the 4IR and/or demonstrate its existence. On the other hand, I am of the view that the current interactions among the previously given entities are not very perceptibly causing the corresponding 4IR effects. For that reason, should the 4IR have started, we still cannot prove that with sufficient theoretical arguments.

The fourth *ntu'ological interactions form* entails interactions among entities of the *ddi, kintu and muntu* categories. That is, whereas it also involves human beings' interactions with *ddi* and *kintu* entities, these interaction forms focus on human-to-human relations. These relations, nevertheless, transcend the routine inter-personal interactions by causing an *ntu'ological* Industrial Revolution adequacy quality or an Industrial Revolution criterion; namely:

unique progression in the human individual's work methods and techniques combined with great transformations of the labor process emerges out of particular human-to-human relations.

The matter of what I term "service economy jobs" during the Digital Revolution or the 3IR may serve as an example to bring to better light the fourth *ntu'ological* Industrial Revolution adequacy quality. To follow is my brief portrayal of the mainly human-to-human interactions that give rise to this adequacy quality.

a) Ddi category entities: The Digital Revolution or the 3IR, in my view, *began* with the iconic invention of the Internet in the United States of America *in 1969 and continues up to date*;

b) Kintu category entities: The service economy jobs are fulfilled using work material, such as laptop computers, desktop computers, scanning machines, cell phones, digital cameras, photocopy machines, and so on;

c) Muntu category A entities: the few individuals employed by national or global companies or elites as employees doing highly-skilled, well or highly paid jobs in scaled-down and well-organized, digitally networked workplaces;

d) Muntu category B entities: the many individuals employed by national or global companies or elites as employees doing unstable, low-skills, low-wage jobs;

e) Muntu category C entities: the very many unemployed individuals who are capable of doing highly-skilled jobs.

Certainly, my brief portrayal of the service-economy-jobs leaves out many instances which characterize the labor force situation in the 3IR. However, it alludes to three key facts: the reality of the internet fundamentally changing the job market; the individualisation of work; and the steady shift from manufacturing to service economies.

Since what the above-given depiction presents is a typical 3IR situation that is still visible up to date, one, therefore, questions: Can we reliably use theoretical reason to prove that instead of observing the continuation and progression of a standard 3IR situation we are seeing a uniquely novel worldwide 4IR evolution in the human individuals' work methods and techniques, a progression that bears the following three characteristics? That is, an advancement which is not an extension of 3IR developments; innovation that is rightly associated with great 4IR transformations of the labor process; and progression, which also results from special global human-to-human interactions. In view of the fact that the previously posed question can almost not be answered affirmatively, it is prudent to state that: should the 4IR be already upon us, even so, we cannot prove that with an adequate sum of theoretical reason.

The fifth *ntu'ological interactions form*, too, regards interactions among entities of the *ddi, kintu* and *muntu* categories. The respective interactions construct, as well, a cause of an *ntu'ological* Industrial Revolution

adequacy quality. However, the pattern of dealings, in this case, occurs in such a manner that a distinct adequacy quality or Industrial Revolution criterion is produced as a result; namely: the interactions among those entities bring into being an inimitable development in the human individual's work methods and techniques combined with great transformations in employment and/or industrial relations.

A case taken from the Second Industrial Revolution days aims to go into some detail in respect of the previously presented *ntu'ological* adequacy quality. It regards Fredrick Taylor's (1911) approach to maximizing factory productivity using novel ways, such as training and supervising employees with the specific objective of uplifting the respective workers' methods and techniques of work. Some of the most notable outcomes of Taylor's approach were his assembly line and the manufacturing of interchangeable parts. These two outcomes transformed the labor process in factories starting with factories in the United States of America (SCOVILLE 2001).

The following abridgment is meant to demonstrate the interactions among the entities of *ddi, kintu* and *muntu* categories that generated the adequacy quality here in discussion.

a) *Ddi* category entities: Taylorism flourished in the United States of America and elsewhere (SCOVILLE 2001) *from the beginning of the 20th Century*;
b) *Kintu* category entities: The *assembly line and the manufacturing of interchangeable parts* transformed the labor process in factories;
c) *Muntu* category entities: Improved work conditions appear to have bolstered the conflict of aspirations of *factory employers and employees*.

A 4IR-possible-existence matter that emerges subsequent to the foregoing reflection on the fifth adequacy quality is the following question: Using theoretical reason, can we substantiate the reality of observable 4IR interactions among entities of the *ddi, kintu* and *muntu* categories, interactions that are leading to global and inimitable 4IR improvement in the human individuals' work methods and techniques? My view on improvement is one that is connected to great transformations in employment and/or industrial relations. Since, in my view, we cannot authenticate that reality, I find it academically prudent to assert that: the 4IR may have started, but we lack adequate theoretical reason to prove its onset.

The sixth *ntu'ological interactions form* considers an additional variety of relations among entities of the *ddi, muntu, kintu, kantu,* and *wantu* categories. An *ntu'ological* Industrial Revolution adequacy quality emerges out of those relations; namely: the respective *ntu'ological* interactions generate growth of an intense desire in human individuals to migrate to economically better-off national and international localities, an action that leads to the formation of primarily new neighborhoods and new social life forms.

The subsequent sets of reflections on instances selected from the 1IR times aim to shed more light on the sixth adequacy quality. During the 1IR, most of the industrial growth was concentrated around factory cities and towns. This factor made such urban localities so attractive to migrants from rural areas that they flocked to urban areas in such of employment. Haines and Walsh (1941, 653) as well as Kennedy (1993, 96) describe the atrocious conditions under which such labor migrants lived, conditions that, in my view, must have let down their original desire to migrate to economically better-off localities. The relations among entities of the *ddi, muntu, kintu, kantu,* and *wantu* categories that were entailed in such instances could be abridged thus:

a) The horrendous living conditions that Haines and Walsh (1941, 653) as well as Kennedy (1993, 96) describe emerged during the *times of the First Industrial Revolution* (*ddi* category entities);
b) *Labor migrants*, most especially from rural areas, attempted to realize their desire to migrate to fast-growing cities and towns in Britain in search of work (*muntu* category beings);
c) *Factory machines and equipment* provided a work occasion for the labor migrants (*kintu* category entities);
d) *The poor mode of living conditions* for the migrants is well illustrated thus: "hundreds and thousands of wretchedly poor filled the slums of the great urban communities (HAINES & WALSH 1941, 653)" [*kantu* category entities];
e) *The rural areas* from which the labor migrants hailed, the crowded *cities and towns* where factories were located, and the *ghettos* where the factory workers lived constitute the key *wantu* category entities here in discussion.

The preceding consideration of the sixth *ntu'ological* Industrial Revolution adequacy quality leads one to ask thus: Are there noticeably typical 4IR interactions among entities of the *ddi, muntu, kintu, kantu* and *wantu* categories that are causing novel and worldwide growth of an intense desire in human individuals to migrate to economically better-off national and international localities thus leading to the formation of primarily new neighborhoods and new social life forms? What exists, that is! If the 4IR is already upon us, then it is upon us. But, in case, it has by now started, we cannot demonstrate this using theoretical reason.

The seventh *ntu'ological interactions form* incorporates dealings among entities of the *ddi, kintu, muntu* and *wantu* categories. The respective cohesion occurs in such a manner that the following adequacy quality or Industrial Revolution criterion is consequently produced, namely: in specific sovereign states, there arise localized transformations, but these transformations are set in motion by the respective states' international political and socio-economic relations. I shall take instances from the 1IR, 2IR and 3IR to substantiate this adequacy quality statement.

During the 1IR, the industrial transformation, which was localized in Britain, was majorly promoted by Britain's transcontinental trade dealings with other states or nations (BECKERT 2014, 23). Let us sum up the relevant interactions among entities of the *ddi, kintu, muntu* and *wantu* categories as follows:

a) The respective trade dealings took place during the *1IR period of time* (*ddi* category entity);
b) Politicians and traders from Britain, India, Africa, the Americas were involved in those trade dealings (*muntu* and *wantu* category beings);
c) Cotton and textiles composed the key trade commodities (*kintu* category entities);

Moreover, describing the salient features of the 2IR, Hobsbawn (1989) proposes that "the major fact about the nineteenth century is the creation of a single global economy" (1989, 62). In addition, he portrays that international situation as an occasion where developed countries got linked with each other and with the undeveloped world (HOBSBAWN 1989, 62). What Hobsbawn demonstrates as "countries being or getting linked with each other" must have been a driving factor that, in my opinion, set in motion a series of localized transformations in each of the respective countries. To follow is an abridgement of the relations among the *ddi, kintu, muntu* and *wantu* categories which must have transpired in that case.
a) *Ddi* category entities: The situation that Hobsbawn (1989) describes arose during the 2IR times;
b) *Muntu* and *Wantu* category entities*:* The key people involved in that global economic situation were politicians and traders hailing from what Hobsbawn considers as the then global economic nexus, namely: Germany, France, Belgium, Italy, Britain, the United States of America, Denmark, the Swedish-Norwegian Union and Japan (1989, 21);
c) *Kintu* category entities comprised material things that were used to realize economic transactions, communications and movements of human beings, commercial goods and financial currency.

Further, in the case of the 3IR, the fully internationalized economy which characterizes this epoch has been enabled by a global "technological infrastructure" (CARNOY & CASTELLS 2001, 3). In my view, such networked technology enables transformations that are localized in a particular state to be augmented or shared through the respective state's international political and socio-economic relations.

The foregoing reflections on the seventh *ntu'ological* adequacy quality lead us to ask this 4IR-possible-existence question: Are there typically novel 4IR global transformations that arise out of interactions among entities in the *ddi, muntu, kintu* and *wantu* categories in such a manner that while they are localized in specific states and nations, they are indeed set in motion by those states' and nations' international political and socio-economic relations?

I am of the view that authenticating the existence of typically novel global transformations, which are not an extension of the 3IR transformations is at this point in time an exigent matter. Accordingly, I may cautiously assert that: whilst the 4IR may have already started, we cannot, however, prove this using theoretical reason.

The eighth *ntu'ological interactions form* includes interactions among entities of the *ddi, muntu, kintu* and *kantu* categories which take place in such a way that the following adequacy quality or Industrial Revolution criterion is created as a result; that is: long-term and fundamental, technological, socio-economic, cultural as well as political transformations are born out of the interactions.

Examining the time-spans of the already accepted three Industrial Revolutions may make clearer the eighth *ntu'ological* adequacy quality statement. The 1IR, which was centred on Britain's industrial transformation has generally been dated as 1760-1840. The 2IR was characterized by the bolstering of colonialism and the creation of a single global economy. These events are commonly positioned within the 1865-1915 timeframe. Certainly, the more or less ninety years of the 1IR and the roughly seventy years of the 2IR are long-enough spans of time for interactions among *ntu* entities to cause specific Industrial Revolution transformations.

However, the truncating of the 3IR to between forty and fifty years by scholarly positions of academics, such as Schwab (2016), McGinnis (2018) and Marwala (2020), who claim that the 4IR is evidently already upon us, would be credible if there were fundamental transformations emerging out of interactions among entities of particular *ntu* categories.

Hence, a 4IR-possible-existence question emerges: Do we have anywhere in the world 4IR decades-old fundamental technological, socio-economic, cultural as well as political transformations arising out of the interactions among entities in the *ddi, muntu, kintu* and *kantu* categories, but which do not originate in the Second or Third Industrial Revolutions? It would be the existence of such transformations that would authenticate the 4IR-existence-premise. Given that we still lack evidence that is based on solid theoretical reason, we should only predict the onset and/or the reality of the 4IR.

The ninth *ntu'ological interactions form* encompasses relations among entities of the *ddi, muntu, kintu* and *kantu* categories that occur in such a manner that the next adequacy quality or Industrial Revolution criterion is generated as a result. That is to say that global and fundamental technological, socio-economic, cultural as well as political transformations emerge out of the interactions.

Observing the global expanse of the First, Second and Third Industrial Revolutions does not only make clearer the ninth *ntu'ological* adequacy quality statement, but also discredits 4IR-possible existence claims. While the transformations arising out of the 1IR were centered on the industrial economy

of Britain (LANGE, MAHONEY & VOM HAU 2006), and whereas the 2IR was dominated by what Hobsbawm (1989) terms a global industrial nexus (1989, 21), the effects of those Industrial Revolutions were evident in the entire human world. With regard to the 3IR, whose defining reality is a set of phenomena summarily termed globalization, the international spread of this revolution's transformations is unquestionably clear.

For that reason, I pose a 4IR-possible-existence question: Can we use theoretical reason to prove the reality of interactions among entities of the *ddi, muntu, kintu, kantu* and *wantu* categories during the last decade that have been occurring in such a manner that the human world has gotten specifically 4IR transformations, which are not only globally-established and fundamentally technological, socio-economic, cultural as well as political in nature, but also do not originate in the Second or Third Industrial Revolutions?

The existence of such reality and its respective results is easier stated than proven with adequate reason. Accordingly, I prefer to reiterate the statement of the position that I hold with regard to the onset and existence of novel industrial revolution; namely: whereas the 4IR may have started, we cannot prove that with theoretical reason.

Ntu'ology's Directive Role: African Analytical Systems Generation

Whilst I am inclined to regard what has 'questionably been named 4IR' as an innovations-extension of the Third Industrial Revolution (3IR), I must admit that we live in times of 'cyber-physical systems' (CPS); i.e. systems that are composed of highly-integrated computation, communication, control and physical elements, systems that focus on complex interdependencies and integration between cyberspace and the physical world (CHEN 2017). In the foregoing elaboration on the nine *ntu'ological* Industrial Revolution adequacy qualities, I have endeavored to state my opinion that these days of the 'cyber-physical systems are part of the 3IR.

More so, I am of the view that the existence of cyber-physical systems is known worldwide, and it is of growing concern, especially in the academia. Of special interest to me is the following reality: although the cyber-space era builds on the technologies and infrastructure of the 3IR, the former i introducing an entirely new scenario. What is this scenario?

The technology of the 3IR has, by and large, consisted of what I may simply describe as sets of tools that human beings can name, categorize, take control of and intentionally use to improve human lives. It appears, however, that the cyber-space era is relying upon that scientific and technological background to build technology that is embedded within societies and even within our human bodies (CHEN 2017). Hence, the technology of the cyber-space era cannot be regarded merely as sets of tools that human beings have mastery over; rather that technology must be considered as sets of influential tools and facilitators that manipulate our worldviews, determine our behavior, and impinge on what it means to be human beings.

Since Africa abounds in factors that have constrained technological development and industrialization over decades (Page: 2014), it is worth the while to devote time to considering exactly these five things:

(1) What kind of cyber-space era shifts Africa is experiencing;

(2) How African countries might, collectively and individually, ensure that the cyber-space era creates economic and technological benefits for the majority, rather than the minority in Africa;

(3) How these cyber-space times are manipulating African worldviews;

(4) How these times are determining the collective and individual behavioral patterns of Africans; and

(5) How cyber-space era impinges on what it means to be African human beings.

In order to reflect deeply on the five previously given and other related points, Africa through her scholars needs to generate and use her own systems of analysis or theoretical frameworks, which I name, "African Cyber-space Era Analytical Systems." I regard as an academic challenge the fact of African scholars and governors begging for and indeed borrowing theoretical approaches, methodological perspectives and sets of analytical tools from elsewhere when Africa already possesses theoretical bases out of which equally pertinent African indigenous methodologies could be drawn.

For that reason, by means of this paper, I aim to promote academic efforts that pioneer the generation of the said African indigenous theoretical bases by presenting an outline of *Ntu'ology's* formal causality role in generating African analytical system, a system which, for instance, questions the Fourth Industrial Revolution hypothesis. In fulfilling a formal causality role, *Ntu'ology* would, firstly, interrogate the Fourth Industrial Revolution hypothesis vis-a-vis the archetypal First Industrial Revolution. This is similar to what I have done earlier on when the major attributes of the 'debatably named 4IR' were very briefly subjected to an 'adequacy analysis' procedure to ascertain their compliance with *ntu'ological* industrial revolution adequacy qualities.

Secondly, there would be an examination of the description or definition of the 4IR from the perspective of the seven categories of *ntu'ology*. Thirdly, *ntu'ology* would question what the arguably named Fourth Industrial Revolution is intended and planned to be. Last but not least, *ntu'ology* would academically probe the claimed manifested pattern and essence of 4IR before drawing conclusions on its industrial revolution worthiness.

Conclusions

This paper focused on some elements of the debate concerning the problem of the appropriate analytical approach to framing apposite conditions of Africa's technological advancement. I have endeavored to present my incessant academic effort to demonstrate the regrettable reality of 'Africa scrounging theoretical approaches, methodological perspectives and sets of analytical tools principally from the Western and Eastern Worlds' when she already possesses the indigenous theoretical bases out of which equally pertinent African indigenous methodologies could be drawn.

I have endeavored to concisely elaborate on the importance of and urgency for Africans to start generating contemporary theoretical bases for pertinent African indigenous methodologies in order to respond definitively to socio-economic and scientific transformations wrought by the current cyber-space times. For this reason, *ntu'ology* has been given as an example of a theoretical framework which Africans already possess and could use to confront a lot of African reality issues and to cope with the temper of the cyber-space times.

By subjecting the claimed Fourth Industrial Revolution (4IR) as a whole to brief analytical questioning of an *ntu'ological* nature, this papers is, additionally, a form of personal invitation to other African scholars to question the claimed 4IR's definition, form, pattern, essence, wholeness, since it is a synthesis of many things, the archetype on which it is built and numerous additional matters that concern the 4IR.

Moreover, more African scholars should employ their indigenous systems of thought as formal causes to enlighten us on what the claimed 4IR is intended and planned to be. It is indeed my heart's desire that out of many African accounts of formal causes, fundamental African philosophy principles or general laws shall be generated. Such principles will not only be African in origin but also serve as theoretical bases out of which sector-specific theoretical approaches, methodological perspectives and sets of analytical tools for suiting Africa for arguablly named Fourth Industrial Revolution could be drawn.

Relevant Literature

1. BECKERT, Steven, (Empire of Cotton: A Global History), 2014. Alfred A. Knopf: New York. Paperback.

2. BYTHELL, Duncan, "Cottage Industry and the Factory System," (History Today), pp 17–23, April, 1983. Vol 33. No 4. Web.
3. CARNOY, Martin, and CASTELLS, Manuel, "Globalization, the Knowledge Society, and the Network State: Poulantzas at the Millennium," (Global Networks), pp 1–18, January, 2001. Vol 1. No 1. Web.
4. CHEN, Hong, "Applications of Cyber-Physical System: A Literature Review," (Journal of Industrial Integration and Management), N. P, October 2017. Month of retrieval: May 2021. Web.
5. GREENWOOD, Jeremy, "The Third Industrial Revolution: Technology, Productivity, and Income Inequality," (Federal Reserve Bank of Cleveland Economic Review), pp 2–12, January, 1999. Vol 35. No 2. Web.
6. HAINES, Charles, Grove, and WALSH, Warren, Bartlett, (The Development of Western Civilization), 1941. Henry Holt: New York. Paperback.
7. HOBSBAWM, Eric, John, (The Age of Empire 1875-1914), 1989. Vintage Books: New York. Paperback.
8. KASOZI, Mutaawe, Ferdinand, (Baganda Ntu'ology), 2000. Neuwieder Verlagsgesellschaft GmbH: Neuwied. Paperback.
9. "____". (Introduction to an African Philosophy – The Ntu'ology of the Baganda), 2011. Verlag Karl Alber: Freiburg/München. Paperback.
10. KENNEDY, Paul, (Preparing for the Twenty First Century), 1993. Random House: New York. Paperback.
11. LANGE, Matthew, MAHONEY, James and VOM HAU, Matthias, "Colonialism and Development: A Comparative Analysis of Spanish and British Colonies," (American Journal of Sociology), pp 1412–1462, March, 2006. Vol 111. No 5. Web.
12. MARWALA, T. "Covid-19 Has Forced Us into the Fast Lane of the 4IR Super-Highway," (Daily Maverick), N. P, May 2020. Month of retrieval: May 2021. Web.
13. MARX, K and ENGELS, F. "Manifesto of the Communist Party," (Marxists Internet Archive), N. P, 1848/2010. Month of retrieval: May 2021. Web.
14. MCGINNIS, D. "What is the Fourth Industrial Revolution?" (Salesforce), N. P, October 2018. Month of retrieval: May 2019. Web.
15. MOKYR, Joel, "The Second Industrial Revolution, 1870-1914" N. P, August 1998. Month of retrieval: May 2021. Web.
16. PAGE, John, "Africa in Focus: Africa's Failure to Industrialize: Bad Luck or Bad Policy?" N. P, November 2014. Month of retrieval: May 2021. Web.
17. SCHWAB, Klaus, (The Fourth Industrial Revolution), 2016. World Economic Forum: Geneva. E-book.

18. SCOVILLE, James, "The Taylorization of Vladimir Ilich Lenin," (Industrial Relations), pp 620– 626, October, 2001. Vol 40. No 4. Web.
19. STEARNS, Peter Nathaniel, (The Industrial Revolution in World History), 2012. Westview Press: Boulder. Paperback.
20. TAYLOR, Frederick Winslow, (The Principles of Scientific Management), 1911/1967. Norton: New York. Paperback.
21. THOMPSON, Edward Palmer, (The Making of the English Working Class), 1963. Victor Gollancz: London. Paperback.
22. TOYNBEE, Arnold, "1884 Lectures on the Industrial Revolution in England," (Rivingtons Digitised Harvard University), N. P, June 2008. Month of retrieval: May 2021. Web.

Ideating African Indigenous Knowledge Systems for Africa's Participation in the 4IR: From Content Framework to Process Formation

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Abstract
With its envisioned benefits of increased productivity, enhanced decision making with digital-based tools, qualitative and efficient processes, improved life expectancy rate, etc., the Fourth Industrial Revolution (4IR) is a desideratum for contemporary society. The need to prioritize skills and knowledge needed for the participation of Africa in the 4IR thus becomes imperative. This paper argues for indigenous knowledge systems (IKS) as a possible approach to enhance African participation in the 4IR. Consequently, the paper examines the methodical perspectives that would be appropriate for framing African Indigenous Knowledge Systems (AIKS) as a tool for advancing science and technology. It argues for the process form of ideating IKS against the content forms implicit in the various views on IKS. It is concluded that the process form of ideating IKS – which essentially focuses on the critical analysis of the systematic formations and development of IKS – unearths the epistemological basis for scientific postulations and technological advancement in Africa.
Keywords: African Indigenous Knowledge Systems, Process Form, Fourth Industrial Revolution, Epistemology, Science, Automated Technologies.

Introduction

The question of African participation in the Fourth Industrial Revolution (4IR) is a salient one that remains on the front burner of contemporary African society's economic, socio-political, and cultural engagement. The technological advancement and attendant benefit that the 4IR heralds in the contemporary world make the participation of all and sundry in the 4IR essential. However, the epistemological base or foundation of the scientific paradigm engendering the 4IR is of Western intellectual heritage. Thus, the global south is flooded with technology developed in line with Western values, perspectives, interests, and conceptions. To this end, the participation of Africa in the 4IR has been largely consumerist. This is because Africa has minimal economic capacity for producing automated technological innovations that signal the advent of the 4IR. Except Africa participates by making technological innovations based on the indigenous epistemological foundation

of the Africans, her participation in the 4IR will remain a mere regurgitation of the Western-centric orientations.

This paper employs the analytical method of philosophical rationalization to examine the methodical perspectives that would be appropriate for framing African Indigenous Knowledge Systems (AIKS) as a tool for technological advancement. The hermeneutic method is employed to unveil the interrelation of culture, science, and technology and argue for the African indigenous knowledge system as a participation tool for the 4IR. Exploring the potency of AIKS as a tool for African participation in the 4IR, insightful argumentative stance is applied to interrogate the over-reliance on the content form of ideating indigenous knowledge systems. This is to emphasize the intellectual importance of the process form of ideating AIKS.

The paper observes that the dependence on the content framework – which involves itemizing and showcasing of the materials and cultural instances of the people in a bid to conceptualize IKS – is a major gap in the ideation of AIKS, as it inhibits the exploration of AIKS. This is because the content framework precludes the expansion of IKS beyond the local application, thus making it geography-specific. The process approach, on the other hand, allows for the theoretical analysis and systematic understanding of the formations and development of IKS as it "reduces or dilutes, the location-specific nature of IKS by drawing on the greater universality of formal scientific knowledge" (BRIGGS 2013, 234). An ideating form which reduces the location-specifics of IKS is beneficial for the consideration of IKS as an epistemological process and hence, making IKS serve as a socio-cultural raw-material for scientific postulations and technological advancement. Thus, this makes IKS more acceptable in building up scientific solutions to contemporary challenges.

In what follows, I present a brief overview of the 4IR to show the need for participation of all segments of humanity in the technological advancement that the 4IR makes possible. The significance of 4IR to contemporary existence underscores the imperativeness of African participation. The next section examines the connection between culture and the development of the 4IR. It is argued here that the epistemological and ontological notions inform technological formations of the 4IR of the engineers and tech corporations producing the automated technologies. I then looked at the method of ideating AIKS to showcase its readiness for scientific conceptualization. This is to show the benefits of the process formation of IKS to the participation of Africa in the 4IR. The paper concludes with remarks that include some recommendations for Africa's participation in the 4IR as a producer of automated technologies rooted in the indigenous African knowledge systems.

The Fourth Industrial Revolution (4IR): An Overview

Since the Enlightenment era, the world has witnessed a succession of industrial revolutions that herald scientific and technological innovation of great magnitude. The term industry is used to categorize an essential part of economic activities with the main goal of mass production of material goods and offering equitable services in mechanized, systematized and automatized forms (LASI n.d. n 2014, 239). While industrial is a concept for describing activities that are relating to industry, revolution, on the other hand from the Latin word *revolutio* - 'a turnaround' (DONALD 1874) could be viewed as a "sudden, radical and widespread change in the various structures of society".

Revolution from the parlance of industrialization focuses on the fundamental changes that account for the rapid and radical change in the production of goods and services. The change that industrial revolution (or revolutions of any sorts) ushers in, is such that it is all-encompassing in the quality and magnitude of effect such revolution has on the global world (SCHWAB 2016, 4). The industrial revolution brought about a qualitative transformation in the production of goods and services based fundamentally on the application of science and technological innovations. The industrial revolution, as noted by Lewis Mumford (2009, 87–88), "accounted for the rapid expansion in skills, development of machinery, labour-saving equipment, energy-conserving devices and automation". The Industrial revolution stimulates human life transformations by restructuring labour, engendering new enterprises and technology, creating urban society, quantitative production, and massive exchange, enhancing mass consumption, and increasing energy production. It also engenders the various forms and shades of techno-scientific developments that result into fundamental changes in the economy, politics, socio-cultural, etc. of the world (LAMOLA 2021, 37), as technological innovation and mechanization of production processes brings about paradigm shifts in industrialization.

The first Industrial Revolution, with its apparent beginning in Great Britain during the early 18th Century, witnessed a replacement of the ancient source of power – human, draught animal and wind with steam and coal, to construct and operate more machinery, advanced more inventions and increased productivity; thus heralding high level of progress and prosperity (WYATT 2009, 2–3). The discovery of the steam combustion technology and coal mining was the distinctive factor that defined the commencement of the Industrial revolution. The Second industrial Revolution (2IR) witnessed the use of electricity and oil combustion for power generation. In this period, spanning through the 1870s into the early 20th century, the 2IR marked an unprecedented increase in industrial production and increased transportation modes. (LAMOLA, 2021) noted the computing processing as the distinctive mark of the third Industrial revolution (3IR). Starting from the late 20th century, the 3IR witnessed the transition from electrical to digital innovation. Okoye n.d.n (2020, 69) observed that the 3IR signals the digital revolution–a fusion of communication technologies with renewable electricity and the

technological connection of the global world. It is worth noting that the computational processing stance of the 3IR becomes the launching platform for the Fourth Industrial Revolution (4IR). This is because the 4IR is marked with the emerging confluence of technologies in the digital, physical, and biological domains in the disruptions of the status quo, the transformation of production, consumption and delivery systems.

In the view of Schwab (2016), the 4IR manifests with a disruptive force and diffusive nature. The disruption and diffusion that the 4IR engenders is noticeable in the light of the three main domains of transformative technologies that the 4IR operates with: the physical, digital, and biological. The 4IR is characterized by existing and emerging technologies in robotics, artificial intelligence, nanotechnology, Internet of Things (IoT), cyber-physical systems (CPS), 3-D Printing, quantum computing, and material storage. While giving explicit explanations about the 4IR, Schwab noted that:

> The fourth industrial revolution… is not only about smart and connected machines and systems. Its scope is much wider. Occurring simultaneously are waves of further breakthroughs in areas ranging from gene sequencing to nanotechnology, from renewable to quantum computing. It is the fusion of these technologies and their interactions across the physical, digital and biological domains that makes the fourth industrial revolution fundamentally different from previous revolutions. (SCHWAB 2016, 12)

Thus, the distinctive feature of the emerging 4IR is the fusion of the cyber-physical cum biological in the automation enabled production of goods and services. The 4IR could thus be adjudged beneficial to the contemporary society due to the attendant peculiarity of integrating the physical, mechanical and digital in the quest for solutions to perennial problems of the contemporary age; hence, facilitating new ways of experiencing life, optimizing economic production (LASSI n.d.n 2014); SCHWAB 2016); BARTODZIEJ 2017); PENPRASE 2018); and RASHIED & BHAMJEE 2020).

The attendant benefits of the 4IR to every facet of human existence in the contemporary time, where every social, economic, and political engagement is automated remains enormous. In business, engineering, security, finance, education, politics, social engagements, governance, etc., the technology push of the 4IR continues to drive the forces of development in a way that has not been seen before, and it is still emerging. The 4IR has changed the way we live and work, as no segment of the world is left untouched by its automated technological impacts. Africa, as a continent, is equally touched by the horizon of change that the 4IR heralds.

The Nexus Between Industrial Revolution and Culture

The participation of Africa in the 4IR becomes a subject matter in the wake of the unprecedented changes and benefits that come with it. Abeba Birhane (2020), Naiefa Rashied and Muaaz Bhamjee (2020) and Lamola (2021) and many others have noted the unpreparedness and the lack of technological capacity in Africa, and many countries in the Global South to participate fully in the 4IR. These scholars and many others have argued that Africa is at best having a consumerist participation with little or no stance in producing the automated technologies that define the 4IR. As a matter of fact, Africa's digital infrastructure and technological ecosystem are controlled by Western monopoly (BIRHANE, 2020, 392). Many reasons have been adduced for the low capacity for optimal participation of Africa in the 4IR. Such reasons include the perspectives of the internalist – (LAMOLA 2021) Abiola Azeez and Tosin Adeate (2020); the externalists – (BIRHANE 2020), (RASHIED and BHAMJEE 2020), (MHLAMBI 2020); and from the multi-dimensional view (OKOYE, OGBU, and OME 2020). I do not intend to engage in the argument concerning the causes or factors that are responsible for the abysmal participation of Africa in the production of automated technologies. Rather, attempts will be made to present a possible way to enhance African participation in the development of automated technologies that reflect the intellectual stance of the African culture.

One essential fact is that the crux of transition to and from one level of the industrial revolution to another remains technological advancement (RASHIED and BHAMJEE 2020, 97). Thus, the skills and knowledge that can engender technological advancement are sacrosanct for the participation of Africa in the 4IR. Technological advancement, on its part, is a consequence of scientific postulations. Both technological advancement and scientific postulations are products of the epistemological and ontological realities undergirding the culture of the proponent of a particular technology (LAMOLA 2021, 38). This view is in tandem with Theophilus Okere (2004, 22) that all scientific knowledge is first local knowledge; as well as that of Francis E. Owusu-Ansah and Gubela Mji that "knowledge or science, and its methods of investigation, cannot be divorced from a people's history, cultural content and worldview" (2013, 1). Thus, indigenous knowledge systems (IKS), a systematized codification of any culture's intellectual capacity, is a possible ingredient and rubrics of scientific postulations and technological advancements. Seeing African Indigenous Knowledge Systems (AIKS) as such, makes its consideration as possible tool for advancing an African participation in the 4IR realistic. Thus, the view of the present author that AIKS could be explored for enhancing knowledge and skills needed to contribute meaningfully in the 4IR.

Enunciating the intellectual nexus between culture and technological advancement, Lamola (2021) argues for the critical explication of the cultural and socio-political dynamics related to the production of knowledge, which engenders the designs, appropriation, and transmissions of automated

technologies. This is a task that this paper attempts to deal with by unearthing the intellectual importance of AIKS as a tool for technological advancement in Africa. For instance, every scientific theory is a consequence of speculations or conjectures about the lived experiences of the scientist. The lived experiences, in turn, are an epistemological codification of the life-process of the culture producing the scientist. Arguing further, Lamola opines for the crafting of scientific postulation and technological advancement from endogenous African epistemological and ethical frameworks (2021, 38). The nexus between science, culture and technology makes the examination of the epistemological, intellectual or ontological basis that informs the creation and advancement of technology imperative. Hence, AIKS could be seen as the critical tool for the fourth industrial revolution for African peoples and societies.

African Indigenous Knowledge Systems (AIKS) Defined

In this paper, indigenous knowledge systems (IKS) are taken as the series of knowledge practices of all indigenous cultures. This paper recognizes the existence of various indigenous systems of knowledge acquisition and justification - such as Western, Australasian, Amerindian,. as there are different approaches and outlooks that cultures employed in comprehending the world around us (JIMOH and THOMAS 2015, 117). On the other hand, the emphasis in the exploration of the IKS here will be mainly on the African Indigenous Knowledge Systems (AIKS).

AIKS is viewed here in the prism of studies like (OSMAN 2009); (OWUSU-ANSAH, & MJI 2013); (KAYA, HASSAN and SELETI 2013,; (MUBANGIZI, and KAYA 2015); (KAYA 2016); (JIMOH 2018); and (VELTHUIZEN 2019) to mention but a few, have considered the plurality of AIKS with the justification that. the plural view gives room for diversity of knowledge systems on the African continent. The plural *considerability* for AIKS gives room towards the maintenance of the perspective that there are diverse epistemologies in Africa, and as such, African knowledge process is not isolated if viewed from a global viewpoint (VELTHUIZEN 2019, 189).

Indigenous knowledge is the product of particular cultural settings and is accumulated through a long series of observations transmitted from generation to generation (GADGIL, BERKES, and FOLKE 1993, 151). The diversification of cultural practices that ensures the survival of indigenous people allows for a plurality of knowledge systems (MAURO and HARDISON 2000, 1267). In such knowledge forms, superimposition of a particular cultural worldview is jettisoned, and complementary or integrated knowledge forms are allowed for growth and sustainable development. IKS could, thus, be seen as "the cumulative body of strategies, practices, techniques, tools, intellectual resources, explanations, beliefs and values accumulated over time in a particular locality, without the interference and impositions of external hegemonic forces" (EMEAGWALI 2014, 2).

Content Framework of IKS

The content or praxis perspectives of ideating IKS focuses on the good practices from the lived experiences of the indigenous people. Thus, case studies of the material depicting the ethical, social, technological, architectural, educational and economic practices at the local level are often put forward in the conceptualizing IKS. In other words, in the bid to conceptualize or ideate IKS for further explication and application to solving societal challenges, instances of cultural practices, artifacts creation method, details of human-nature relations, oral forms of teaching-learning styles, etc. oftentimes cited as definitions to what IKS is. Put in another way, attempts at conceptualizing IKS often focus much on content or practise and thus assumed the theoretical formation of the epistemic process along their presentations (BRIGGS 2013, 231). The present author will like to note that glossing over the theoretical and systemic stance of indigenous knowledge formation method with the content form of IKS will be a disservice to the development of IKS in the quest for homegrown solutions to contemporary challenges.

Obtainable from conceptualizing IKS through the practical contents of the people is the method of prioritizing the praxis of IKS over its exploration as an epistemological theory. The content framework is thus identified in this paper as a major gap in the ideation of IKS, especially the African indigenous knowledge systems. The content or practice consideration of IKS helps in the Utilitarian codification of the indigenous peoples' cultural practices (NADUBERE 2006, 7–9), (TEFFO 2013, 189). Nevertheless, the focus on the practical contents of the cultural materials in the ideation of IKS de-emphasises exploration of the theoretical framework of indigenous ways of knowing. Also, as noted by (MCFARLANE 2006); (SILLITOE 2010); and (BRIGGS 2005), (BRIGGS 2013); the utilitarian projections of indigenous practices in comprehending IKS have resulted in an intellectual impasse having little help in the development of science and technology. The main reason for this impasse is the fact that exploring the practical content or unveiling the utilitarian stance of local content glosses over the theoretical formation for the development and deployment of scientific postulation and technological advancement needed for participation in the 4IR.

Process Form of IKS and

The process perspectives of ideating IKS focus on exploring the conceptual or theoretical framework of indigenous ways of knowing. Ideating IKS from the process formation goes beyond merely exploring the repertoire of samples of the genre of geographical, economic, environmental, and cultural setting emerging from local and geographical specifics. Rather, it unveils the theoretical formations of such practices. Taking this route in the conceptualization of IKS helps to avoid one of the essential shortcomings of IKS structured on the local examples of practitioners – the inability of non-

cultural practitioner to understand and export for further usage, the indigenous practices elsewhere. This appears challenging, as the important contributions that IKS makes to deepening local understandings or enhancing the expansion of the repertoire of knowledges may have no effect. The challenge becomes more worrisome in the face of an urgent quest for contemporary developments, reduction of poverty, socio-economic intervention, gender equality and protection, technological advancement etc. (BRIGGS 2013, 233).

In enunciating the significance and essentiality of the process form of ideating IKS to development studies, and by extension the achievability of growth in Africa, John Briggs (2013, 237) further argues that the employing IKS in a theory or process format, rather than a content format is advantageous, because the process format "extends beyond the culturally and spatially bound restriction of geographical thinking". Briggs' view here resonates with that of Fikret Berkes (2009, 152–53), that IK should focus much on process rather than on content. One of the facts to note here is that ideating indigenous thought forms by exploring, through critical and systematic examination, the intellectual path of knowledge formation enhances clearer understanding of the cognitive modes, nature and values of knowledge formation and dissemination in the African context (OYEKUNLE 2021, 193). This perspective of having a grasp of any intellectual thought through rationalizing its conceptual framework is also seen by Minuteman Nkulu-N'Sengha (2005, 40) required for the enhancement of a systematic explanation of how Africans articulate, evaluate and disseminate knowledge. Thus, for the purpose of our discussion on the participation of Africa in the 4IR, the process form of ideating IKS – as will be shown below – reveals the potentiality of AIKS for techno-scientific ideology that is needed for genuine African participation in the 4IR.

Attendant benefits of the Process Formation for 4IR

The challenge of expanding IKS beyond local application and geographical specificity is one of the reasons that make the process formation significant. The content framework for conceiving IKS makes the idea to remain at the periphery of local practice and not functional in integrating knowledge formations in addressing contemporary challenges. For instance, if the call of Cleophas Lado (2004, 281) for a synergy between indigenous knowledge and modern knowledge system to produce a more realistic and sensitive understanding and management of natural resources for sustainable development will be of any help, a theoretical analysis and understanding of the formations and development of IKS remain imperative. One of the advantages of the theoretical formation approach is that it "reduces or dilutes, the location-specific nature of IK by drawing on the greater universality of formal scientific knowledge" (BRIGGS 2013, 234).

Although the content framework is beneficial in showcasing the value, significance and viability of IKS as an alternative way of knowing, the

observed limitation, however obviates scientific practices, hence, could impede the development of skills and knowledge forms required for the participation of Africa in the 4IR. In other words, the indigenous method or process of knowing should be emphasized above the contents of indigenous knowledge. What this means is that attempts at comprehending IKS from the process stance makes ideating IKS an "epistemology of indigenous knowledge systems" (BRIGGS 2013, 237).

Taking IKS as an epistemic study of the indigenous ways of knowing breaks the content constraints as it extends the study of IKS beyond the spatial bound associated with the cultural context of local practices. While the significance of content-conceptualizing approach has been shown earlier, Berkes (2009,154) notes that "not taking knowledge out of its cultural context is one of the biggest challenges of indigenous knowledge research". It is a challenge for the wider and universalizing applicability of IKS in the age of globalization. The process form of ideating IKS obviates this important shortcoming as it presents IKS as a way of knowing within a cultural context, with wider applicability beyond the local context. Justification for the process is also that the process approach helps to unveil the contents for possible intercultural dialogue, international recognition and removes the toga of esoteric nature that often characterizes IKS. Thus, IKS could be made viable in providing possibilities for "new ways of knowing, new ways of thinking and new ways of making development intervention" (BRIGGS 2013, 238).

Furthermore, the process approach allows for the theoretical analysis and systematic understanding of the formations and development of IKS as it "reduces or dilutes, the location-specific nature of IKS by drawing on the greater universality of formal scientific knowledge" (BRIGGS 2013, 234). Reducing the location-specifics of IKS is essential for the application of IKS in scientific postulations, and IKS more acceptable both locally and internationally in building up scientific solutions to contemporary challenges. This is because process emphasizes the understanding of methods for analyzing, questioning, observing, comprehending and rationalizing received or new idea/information. Thus, the process formation of IKS permits for wider and universalizing applicability of AIKS as a systematic tool for enhancing the advancement, measurement, and interpretation of technological innovations required for Africa's participation in the 4IR.

Concluding remarks

One of the significances of AIKS in the production of automated technologies is to stem the danger of lack of control (political, socio-cultural or economical) on the Western-centric technological innovations that shape the 4IR. By virtue of its enormous population and as an emerging market in the global economic valuation, Africa is a hot-spot for importation, dumping, and flooding of technology. Most of these technological importations are developed based on the economic consideration of the producing units – multinational companies

(BIRHANE 2020, 389). Thus, selecting features and data that form the creation and development of these automated technologies will mirror the producer/ designer or creators' ethical values and socio-cultural orientations. As such, it could be argued that, beyond economic reasons – profit maximization – the cultural, political, educational development or economic needs of the African people will be of less concern in the production of automated technologies. This is because these technologies were products of a particular cultural orientation and social paradigm. Hence, they are bound to be projected to cater to its proponents' needs and in line with the indigenous perspectives of the designers.

Although, it could be argued that Africans have the opportunity to adopt the imported technologies to meet their needs. However, such an approach is presently the practice and obviates genuine development because technological inventions are often consequences of need (MHLAMBI 2020, 8). Necessity, it is often said, is the mother of invention. Thus, a people with an alternative means of satisfying their needs (despite the hazards and ills attached to such means) are essentially placed disadvantageously to develop or invent technologies that are rooted in their own indigenous knowledge process. The reason for this line of thought is not far-fetched. Technological innovations are formed based on the consideration of the health orientation, facial/bodily recognition, cultural or social lifestyle, genetic formation, weather, etc., of its proponents. Hence, to improve the same technology for adoptions into any other indigenous usage is to lay the socio-cultural and epistemic foundation of one's technological innovation in an alien technological form. This has been noted by Birhane (2020) as digital colonialism.

Thus, not adopting the indigenous epistemic systems of the Africans in the development of automated technology and artificial intelligence informs the perpetual lack of African footprints in the development of automated technologies or participation in the 4IR. This, in no doubt, accounts for the: (1) perpetual dependent on the West for software and technological infrastructural ecosystem, (2) non-development of local AI products and tools, (3) Identity crisis, (4) Context application and transferability deficiency, (5) data drainage.

Furthermore, the tech-solutions are functions of the subjective conundrums of and economical context of the technological corporations. Thus, the complexities of human, cultural, political, or health processes are oversimplified for the purposes of automation and technological quantifications. Even the engineer, who, for instance, may be of Non-Western origin, has no say in the subjectiveness of the design.

Furthermore, it is essential that the knowledge process of Africa – being presently disproportionately placed vulnerable to automated technological invention – be centred in the problem statement, design, appropriation and implementation of the technology driving the 4IR. Ideating IKS in the content framework will be of less benefit in centring IKS in the

development and invention of automated technology. This is because the content framework de-emphasises the exploration of theoretical analysis, which is needed for the development of scientific postulations and technological innovation, that characterizes the techno-scientific ideology of the 4IR. Ideating AIKS in the process formation, on the other hand, allows for the systematic and logical consideration of the AIKS in the design of the algorithmic process. This will ensure that consultation and involvement of the indigenous people are imputed in the creation process of automated technologies.

Ideating AIKS on the process formation informs the communal values that are engendered by the unitary ontological perception of reality in Africa. Such ontological perception obviate the epistemic capturing of the human persons as object of data analysis, or what Birhena (2020, 392) calls "human natural resources", thus, recognizing the inclusion or consideration of the contextual "afro-existentialism" (AZEEZ and ADEATE 2020, 49) of the Africans in the design, appropriation and development of the automated technologies.

On a final note, this author would like to emphasize that the content framework of ideating IKS appears necessary as an example and instances of materials from the shared experiences and communal stance of African practice and norms that could be developed as techno-scientific invention for the AI. The content framework, however, appears insufficient as an outlook that can be factored into the design, appropriation and ordering of algorithmic patterns that undergird automated technology. The process form of ideating IKS is significant in this instance. This is because the process form of ideating IKS sets up the means of making Indigenous communal values and practices codifiable into machine language, robotics designs and technological automation. Epistemology informs the cultural stance of understanding and applying reality. Bunyan Bryant (2011), in arguing for the significance of epistemology in sustainable development, captures this point well. He opines that "the value and social construction of epistemology inform our pedagogy, our scientific inquiry and our truth" (BRYANT 2011, 14). It could thus be argued alongside Bryant here, that epistemology – as a tool for constructing and understanding reality – has social inquiry ability and valuation to inform our morality, scientific enquiry, technological quest, and the development of AI. Thus, ideating IKS on the process form makes IKS constructable with both the descriptive and prescriptive outlook for advancing an automated technology that is compliant with the African knowledge system.

Of a beneficial stance to the contemporary African states, developing the algorithmic patterns for the design of automated technology of AI, and the 4IR by extension, from the process framework of IKS makes the research and design of the AI technology to have an indigenous outlook. Such an outlook makes AI technology to be compliant, thus, codable with the communal and ontological context of the African space. In essence, the viability of the

process form of ideating IKS to engender critical analysis of the systematic formations and development of IKS is worth noting here as a desired tool for the participation of Africa in the 4IR. This is because the process form of ideating IKS unearths the epistemological basis for scientific postulations and technological advancement from an African context.

Relevant Literature

1. AZEEZ, Abiola., & ADEATE, Tosin. "Second-Wave AI and Afro-Existential Norms," [Filosofia Theoretica: Journal of African Philosophy, Culture and Religion], pp49–64, 2020. Vol 9. No3. https://dx.doi.org/10.4314/ft.v9i3.4
2. BARTODZIEJ, Christoph J. [The Concept Industry 4.0:An Empirical Analysis of Technologies and Applications in Production Logistics], 2017. Springer Gabler: Wiesbaden, GmbH. https://doi.org/10.1007/978-3-658-16502-4
3. BERKES, F. "Indigenous Ways of Knowing and the Study of Environmental Change," [Journal of the Royal Society of New Zealand], pp 151–156, 2009. Vol 39. No4.
4. BIRHANE, Abeba. "Algorithmic Colonization of Africa," [Scripted], pp389–409, 2020. Vol 17. No2. https://doi.org/10.2966/scrip.170220.389
5. BRIGGS, John. "The Use of Indigenous Knowledge in Development: Problems and Challenges," [Progress in Development Studies], pp99–114, 2005. Vol 5. No2. Pdf.
6. ———."Indigenous Knowledge: A False Dawn for Development Theory and Practice?," [Progress in Development Studies], pp231–243, 2013. Vol 13. No3.
7. BRYANT, B. [Environmental Crisis or Crisis of Epistemology? Working for Sustainable Knowledge and Environmental Justice], 2011. Morgan James Publishing: New York, NY.
8. DONALD, James. Ed. [Chambers's Etymological Dictionary of the English Language] 1874. W & R Chambers: London, Edinburgh.
9. EMEAGWALI, Gloria. 2014. "Intersections Between Africa's Indigenous Knowledge Systems and History," [African Indigenous Knowl-Edge and the Disciplines], Gloria EMEAGWALI, & George J. SEFA DEI Eds., pp1–17, 2014. Sense Publishers: Rotterdam. Paperback

10. GADGIL, Madhav., BERKES, Fikret., & FOLKE, Carl. "Indigenous Knowledge for Biodiversity Conservation," [Ambio], pp151–56, 1993. Vol 22. No2/3. http://www.jstor.org/stable/4314060.
11. JIMOH, Anselm & THOMAS, John. "An African Epistemological Approach to Epistemic Certitude and Scepticism," [Exploration in African Philosophy: Essays in Honour of Anthony O. Echekwube], Blessing IGBAFEN, & Monday AGIDIGBI Eds., pp113–24, 2015. Bwright Integrated Publishers Limited: Ibadan. Paperback.
12. JIMOH, Anselm Kole. "Reconstructing a Fractured Indigenous Knowledge System," [Synthesis Philosophica], pp5–22, 2018. Vol 65. No1. https://doi:10.21464/sp33101
13. KAYA, Hassan O. & SELETI, Yonah N. "African Indigenous Knowledge Systems and Relevance of Higher Education in South Africa," [The International Education Journal: Comparative Perspectives], pp30–44, 2013. Vol 12. No1.
14. KAYA, Hassan O. "Cultural Values and African Indigenous Knowledge Systems in Climate Change Adaptation," [Journal of Social Sciences], pp130–36, 2016. Vol 46. No2.
15. LADO, C. "Sustainable Environmental Resource Utilisation: A Case Study of Farmers' Ethnobotanical Knowledge and Rural Change in Bungoma District, Kenya," [Applied Geography], pp281–302, 2004. Vol 24. No4. DOI:10.1016/j.apgeog.2004.03.002.
16. LAMOLA, Malesela John. "Africa in the Fourth Industrial Revolution: A Status Questionis, from the Cultural to the Phenomenological," [African Values, Ethics, and Technology: Questions, Issues, and Approaches], Beatrice Dedaa OKYERE-MANU Ed, pp35-52, 2021. Palgrave Macmillan: Cham, Switzerland. https://doi.org/10.1007 / 978-3-030-70550-3
17. LASI, Heiner., KEMPER, Hans-George., FETTKE, Peter., FELD, Thomas., & HOFFMANN, Michael. "Industry 4.0," [Business & Information Systems Engineering], pp239–42, 2014. Vol 4. https://doi.org/10.1007/s11576-014-0424-4
18. MAURO, Francesco.; and HARDISON, Preston D. "Traditional Knowledge of Indigenous and Local Communities: International Debate and Policy Initiatives," [Ecological Application], pp1263–69, 2000. Vol 10. No5. Pdf.
19. MCFARLANE, C. "Transnational Development Networks: Bringing Development and Postcolonial Approaches into Dialogue," [Geographical Journal], pp35–49, 2006. Vol 172 No1.
20. MHLAMBI, Sabelo. [From Rationality to Relationality: Ubuntu as an Ethical & Human Rights Framework for Artificial Intelligence Governance], 2020. 009. Carr Centre Discussion Paper Series: Cambridge, MA.

https://drive.google.com/file/d/1dhhWE9pIT9Ko77XID7XHwGvlPTgGf8wL/view?usp=sharing.
21. MUBANGIZI, John. & KAYA, Hassan. "African Indigenous Knowledge Systems and Human Rights: Implications for Higher Education, Based on the South African Experience," [International Journal of African Renaissance Studies - Multi-, Inter- and Transdisciplinarity], pp125–42, 2015. Vol 10. No2.
22. MUMFORD, Lewis. "Technics and Civilization," [Encyclopaedia of Environmental Ethics and Philosophy] Baird CALLICOTT & Robert Frodeman Eds., pp87-92, 2009. Macmillan Reference: New York.
23. NADUBERE, D. W. "Towards an Afrikology of Knowledge Production and Regeneration," [International Journal of African Renaissance Studies], pp7-32, 2006. Vol 1. No1.
24. NKULU-N'SENGHA, Mutombo. "African Epistemology." [Encyclopedia of Black Studies] Molefi Kete ASANTE & Ama MAZAMA Eds., pp39–44, 2005. Sage Publications, Inc: California. https://epdf.pub/encyclopedia-of-black-studies.html
25. OKERE, Theophilus. "Is There One Science, Western Science?," [Africa Development], pp 20–31, 2004. Vol XXX. No3.
26. OKOYE, Uche Miriam., OGBU, Esther Obiageli., & OME, Gerald Ejiofor. "The Place of Africa in the Fourth Industrial Revolution," [Filosofia Theoretica: Journal of African Philosophy, Culture and Religion], pp65–84, 2020. Vol 9. No3. https://doi.org/https://dx.doi.org/10.4314/ft.v9i3.5.
27. OSMAN, S. A. "Indigenous Knowledge in Africa: Challenges and Opportunities". Inaugural Lecture University of Free State, 2009. Retrieved July, 2021 https://www.ufs.ac.za/docs/librariesprovider20/centre-for-africa-studies-documents/all-documents/osman-lecture-1788-eng.pdf?sfvrsn=e436fb21_0
28. OWUSU-ANSAH, F.E. & MJI, G. "African Indigenous Knowledge and Research." [African Journal of Disability], pp1-5, 2013. Vol 2. No1. https://doi.org/10.4102/ajod.v2i1.30.
29. OYEKUNLE A. A.. "An Exploration of an Indigenous African Epistemic Order: In Search of a Contemporary African Environmental Philosophy," [Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy (PhD) in the Department of Philosophy, Practical and Systematic Theology, University of South Africa], June, 2021. http://hdl.handle.net/10500/27624.
30. PENPRASE, Bryan E. "The Fourth Industrial Revolution and Higher Education," [Higher Education in the Era of the Fourth Industrial Revolution], Nancy W. GLEASON. Ed., pp207-229, 2018.

Springer Nature: Gateway East, Singapore. https://doi.org/10.1007/978-981-13-0194-0_9.
31. RASHIED, Naiefa. & BHAMJEE, Muaaz. "Does the Global South Need to Decolonise the Fourth Industrial Revolution?," [The Disruptive Fourth Industrial Revolution: Technology, Society and Beyond], Wesley DOORSAMY, n.d.n. Eds., pp95–110, 2020. Springer Nature: Cham, Switzerland. https://doi.org/10.1007/978-3-030-48230-5_5.
32. SCHWAB, Klaus. [The Fourth Industrial Revolution], 2016. World Economic Forum: Cologny-Geneva. https://luminariaz.files.WordPress.com/2017/11/the-fourth-industrial-revolution2016-21.pdf.
33. SILLITOE, P. "Implications, Trust in Development: Some Knowledge, of Knowing in Indigenous," [Journal of the Royal Anthropological Institute], pp12–30, 2010. Vol 16. No3.
34. TEFFO, Lesiba. "Rural Communities as Sites of Knowledge: A Case for African Epistemologies," [Indilinga - African Journal of Indigenous Knowledge Systems], pp188–202, 2013. Vol 12 No2.
35. VELTHUIZEN, Andreas. "African Knowledge as a System: Towards Global Parity in Knowledge Production For Democratisation, Socio-Economic Growth And Human Development," [Indilinga: African Journal of Indigenous Knowledge Systems], pp189–200, 2019. Vol 18. No2.
36. WYATT, Lee T. [The Industrial Revolution], 2009. Greenwood Publishers: Westport, Connecticut. https://eds.b.ebscohost.com/eds/ebookviewer/ebook/bmxlYmtfXzI4MDg0Nl9fQU41?sid=7223d3fe-8cf4-4f85-8734-02ec38ebc34c@sessionmgr101&vid=0&format=EB&rid=1.

Fourth Industrial Revolution and Geopolitics of Knowledge Production: The Question of Africa's Place in the Global Space

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Abstract
Francis Fukuyama postulated that there are two powerful forces at work in human history. One, he calls, 'the logic of modern science' and the other, 'the struggle for recognition'. I agree with Fukuyama that human developmental progression is propelled by these twin principles. It is my position that these principles have been the drivers of geopolitics. In this paper, I argue that, in addition, knowledge production is a major factor in geopolitics and that the Euro-American worldview has occupied the place of hegemony by reason of knowledge production. Africa has been denied having any form of epistemic tradition by the Euro-American world to sustain itself in the position of hegemony. In the era of Fourth Industrial Revolution, it will be antithetical for Africa to continue to adopt or consume technologies driven by Eurocentrism without projecting its contribution to the global space. Hence, using a critical hermeneutical approach, I contend that Africa needs to make a unique African contribution in the era of Fourth Industrial Revolution. It is Africa's unique contribution that will guarantee Africa a place in geopolitics.
Keywords: Fourth Industrial Revolution, Geopolitics, African place, Struggle for Recognition, Knowledge Production

Introduction

The history of humanity has been associated with a clash of opposites or dialectics, as was envisaged by Hegel. This dialectical movement is progressive in nature and represents the picture of human developmental progress. It was Francis Fukuyama who presented evidence to suggest that there are two powerful forces at work in human history. One he calls "the logic of modern science" and the other "the struggle for recognition" (1992, xv). Going by the logic of Fukuyama's argument, one can argue that humanity has moved from First Industrial Revolution to the Fourth Industrial Revolution by reason of the logic of modern science and the struggle for recognition. This struggle for recognition is coeval with human nature. From a historical perspective, humanity has always clamored for recognition. Fukuyama put it thus, "Man's sense of self-worth and the demand that it be recognized has, up till now, been presented as the source of noble virtues like courage, generosity,

and public-spiritedness…" (1992, 181). This axis of 'logic of modern science' and 'the struggle for recognition' has been part of human history, only that they were not clearly addressed as such, rather they have taken various forms and shapes in the course of history. Call it colonialism, neo-colonialism, Eurocentrism, or Western epistemic hegemony, the focus is that a particular epistemic tradition has placed itself in the position of recognition above others and in a bid to sustain this position of hegemony has denied others of epistemic possibility.

It is interesting to note that geopolitics is a reflection of what is obtainable in individuals. The desire for recognition is part and parcel of human nature. At the geopolitical level, the same desire for recognition is also obtainable. The challenge with this desire is that it is to the detriment of other presupposed 'lesser' countries. Since everyone will like to be recognized; who should be recognized becomes a problem. Who is to perform the act of recognition is also a problem. One cannot fully enjoy the experience of this recognition if one is both the recognized and the recognizer. At the geopolitical level, a country cannot be both the recognizer and the recognized. It is more logical to posit that knowledge production becomes the paradigm for recognition. It is my contention that knowledge production has played a significant role in geopolitics, while the struggle for recognition is the driving force of this knowledge production, and Africa has been on the receiving end.

After the First Industrial Revolution, some countries became strong and powerful, while others became weak and subservient to these powerful countries. It is worthy of note to state that after the First Industrial Revolution, a divide was created between those who produce technology and those who consume it. The ability of countries to produce technology of the moment determines their place in the global schema of things. History has shown that in geopolitics, nothing is given, rather a peoples' contribution to knowledge determines what their lot becomes. Harold Lasswell's (1936) work "Politics: Who gets What, When and How" explains it better. In geopolitics, who gets what, when and how is largely determined through competitive struggle. Unfortunately for Africa, the Euro-American world has craftily placed itself in a position of scientific hegemony, thereby denying Africa and others the possibility of knowledge production. Euro-American epistemic tradition is placed above other traditions, and it also serves as scientific paradigm to other epistemic traditions. Eurocentrism has succeeded in creating a divide between the West (Global North) and the Global South. While the West represents the ideal, others are portrayed as the opposite. While the West is recognized and celebrated, others are perceived to exist only by the mercies of the West. Ramon Grosfoguel aptly captures it thus:

> We [people of the 'Global South'] went from the sixteenth-century characterization of "people without writing" to the eighteenth and nineteenth-century characterization of "people without history", to the twentieth-century characterization of "people without development" and more recently, to the early twenty-first century of "people without democracy". (2020, 214)

This characterization is the divisive nature of geopolitics. The geopolitical rating or placing of a people is largely determined by their knowledge contribution. For Lamola, "the production of knowledge and the design of technological artefacts is the most urgent task of contemporary African social science and philosophy" (2020, 2). The polarization of the world is based on knowledge production. The First World, Second World, and Third World dichotomy, the Global North and Global South divide and the developed and the developing split, I would like to argue, are all occasioned by knowledge production and the desire to be recognized.

For so long, Africa has played a reactionary role. Early African philosophers were subjected to the agony of proving the existence of African philosophy instead of doing African philosophy. This subjected agony helps to strengthen the divide between the Global North and the Global South. In this paper, I contend that the Fourth Industrial Revolution is and still remains a continuation of the old system, the system of Western epistemic dominance. Hence, African holistic acceptance of the technologies associated with the fourth industrial revolution without providing its contribution to the entire narrative will promote and encourage Western epistemic dominance. It is an opportunity for Africa to address the problem of 'epistemic injustice' a term coined by Miranda Fricker. According to Chimakonam, the notion of epistemic injustice was a result of the European negligence of the Africa's contributions to knowledge production (2017, 120). The Westerners have for years seen Africans as pre-logical and irrational. It is arguably not out of order to posit that in the past, Africa was unable to profit and make the most of the opportunities brought by previous industrial revolutions. Consequently, this has placed Africa in a disadvantaged position *vis a vis* other competitors. I contend that in this era of fourth industrial revolution, there is a need for Africa to focus on African epistemic tradition, which takes cognizance of African realities as this will form her contribution to knowledge production and enhance her place in geopolitics. If Africa must participate in geopolitics in this fourth industrial revolution era, her focus must be on knowledge production.

The Fourth Industrial Revolution

The term fourth industrial revolution was coined by Klaus Schwab, founder of the World Economic Forum. The term represents a world where individuals use connected technology to aid and manage their lives (MILLER 2016, 3).

For Schwab, the fourth industrial revolution is not just about smart and connected machines and systems. It has a much wider scope ranging from gene sequencing to nanotechnology, from renewables to quantum computing. It also involves the fusion and interaction of technologies across the physical, the digital and the biological domains. It is this kind of interaction that makes the fourth industrial revolution different from previous industrial revolutions (MILLER 2016, 12). The fourth industrial revolution has totally transformed the world from what it used to be to an entirely novel phenomenon. The technology of the fourth industrial revolution is a quantum leap from that of third industrial revolution. This is typified with rapid change and development in the various facets of human life. It is associated with innovative technologies such as AI, the internet of things, robotics, 3D printing, Blockchain, nanotechnology, and others with applications as diverse as the technologies themselves (SCHWAB 2016, 7).

The Fourth Industrial Revolution significantly has almost altered everything about humans and their universe, and it is unfolding at an extremely fast pace. It comes with both merits and demerits to Africa. The use of artificial intelligence (AI), robotic machines and other digital agents associated with the fourth industrial revolution (4IR) generally have helped in enhancing the quality of human life. It has brought much precision in the area of agriculture and healthcare. One of the major challenges associated with the fourth industrial revolution in Africa is the fact that "Africa cannot as of today be characterized as a producer of 4IR technologies, but rather as an adopter of existing technologies produced and developed elsewhere in the world" (AfDB STUDY REPORT 2019, 16). This possibly has affected Africa in the areas of values, cultures, norms, traditions, orientation, job creation and security. For Reagan and Singh, the fourth industrial revolution covers and affects almost all aspects of human endeavor, ranging from agriculture, automotive, consumer, energy, financial services, health care, manufacturing, media and entertainments, retails, transportation and travel (2020, v). The wide coverage of the fourth industrial revolution has made it irresistible. Our focus is on how Africa can truly benefit from the fourth industrial revolution without promoting eurocentrism. Africa cannot achieve this without first addressing certain geopolitical structures militating against Africa.

Geopolitics of Knowledge Production

Today, there is this unseen institutionalized structure that favors the Western world and constitutes a great impediment specifically to Africa. One may refer to it as Euro-American hegemony. The Euro-American world has created this structure and is not willing to dismantle it any time soon. Obviously, the Asians, especially China, have come to understand how this works and has placed itself as a very strong global competitor. This is evident when one considers Rush Doshi prepared statement presented before U.S. Senate Committee on Commerce, Science, and Transportation, Subcommittee on

Security dated July 30, 2020. Doshi began with the claim that China is pursuing a robust, state-backed effort to displace the United State from global technology leadership. This effort, in his view, is not driven entirely by commercial considerations but geopolitical ones as well (2020, 2). Doshi posits thus: "Beijing believes that the competition over technology is about more than whose companies will dominate particular market. It is also about which country will be best positioned to lead the world" (2020, 2). While Africa is calling for intercultural dialogue, the Asians have taken a step ahead by presenting their narrative through technology. My position is not against intercultural philosophy, rather my argument is that beyond intercultural disposition, there is a need to present unique African contribution/s in the area of technology as such will guarantee a place for Africa in geopolitics.

The Euro-American hegemony has permeated every aspect of scientific inquiry, and it is a core part of geopolitics. It places Euro-American ideas and categories far above other world views. More so, other world views (especially Africa) are subjected to these Western categories before they can gain acceptance. In other words, the West seem to determine what could pass as scientific and unscientific. This is the unfortunate situation of Africa today. A recent case that will be of interest to us and that will also serve as a reference to the above claim has to do with the challenge of Corona Virus. While there were claims from some African countries about the cure to the disease, these claims were outrightly rejected by World Health Organization, and it seems they were waiting for the solution from a particular place. It was obvious that the virus has been more lethal in the West than in Africa, yet all the claims from Africa were considered dead on arrival. On this note Madagascar's President Andry Rajoelina slammed the World Health Organisation for not endorsing its COVID 19 herbal cure. For him, "if it were a European country which had discovered this remedy, would there be so many doubts" (11th May, 2020). Whatever be a scientific discovery it must conform and be explainable within Western categories. Paasi refers to it as, "Academic Capitalism and the geopolitics of knowledge" (2015, 1). Lamola rightly observes that:

> In the fourth industrial revolution, modern technologies are expressly produced for global consumption, while the scientific paradigm that shapes the nature and the use of these technologies, including their digitalization of human life is derived from a geoeconomic base that is constituted by a particularized political and geo-cultural circuity. (2020, 2)

He (Lamola) went further to assert that, since the first industrial revolution, the Euro-American epistemic tradition and intellectual heritage have ascended into a position of a hegemon on scientific research and technological innovation, while Africa remains trapped into the status of a net importer and consumer of this technology that happens to be molding her self-knowledge and social character (2020, 2).

Hountondji in his article titled "Scientific Dependence in Africa Today" quoted at length from Jacques de Certaines a French biologist to portray how Africans are trained to be scientifically dependent on the Euro-American world. In his view, an unfortunate system has been created in Africa. This unfortunate system has created a feeling in most students of African universities that whatever their special fields might be, everything that matters for them is located or taking place elsewhere. Elsewhere, outside Africa are located the most fully equipped laboratories, the best universities, the most powerful research centers, the editorial teams and offices of the most prestigious scientific journals, complete reference libraries and publishing houses, and lastly, the world's major concentration of practicing scientists (HOUNTONDJI 1990, 6). The challenge here is not just that Africans are subjected to this predicament, but that most Africans do not see anything wrong with it. The acceptance and unquestioned attitude of some African scholars to this trend is a major issue of concern. This is how geopolitics has played out: everything the West is associated with is scientific, critical, and objective. The reverse is the case for Africa. Knowledge production gains quick acceptance when it is emerging from the West and faces great obstacle when it is emerging from Africa. Chimakonam writing on "African Philosophy and Global Epistemic Injustice" states thus, "The imposition of a cultural appurtenance of the Global West on the rest of humankind creates a serious schism in the order of knowledge" (2017, 125). Western intellectual heritage is considered universal and constitutes the paradigm to which Africa and others must adhere to.

My question is, why has the Western epistemic tradition taken the place of epistemic hegemony? The answer to this question is explainable using Fukuyama's view on the idea of 'struggle for recognition'. It is important for me to explain Fukuyama's context and my context in the usage of the term.

The focus of Fukuyama's argument is to prove that liberal democracy is the end of all forms of ideological revolutions. He argued that the struggle for recognition which is an innate part of human nature has been a major force that triggers ideological revolution, and within liberal democracy this struggle for recognition is satisfied, therefore, there will be no need for further ideological revolution, hence, the end of history. But I saw in Fukuyama's argument the answer to the epistemic imbalance in our world today. I also saw the logical explanation of why the West will continue to perpetuate itself in the position of hegemony. Fukuyama's idea of the 'struggle for recognition' was deduced from Hegel and Alexandre Kojeve's (the French-Russian philosopher) interpretation of Hegel. For Hegel, human beings like every other animal have natural needs and desires for objects such as food, shelter and the preservation of their own bodies. But human being fundamentally differs from other animals in that above all these desires, the human being has the desire for other human beings; she wants to be 'recognized'. I am not much interested in Hegel's idea per se or Kojeve's interpretation of Hegel but rather on how the idea was presented by Fukuyama.

Fukuyama thus posits, "In particular, he wants to be recognized as a human being, that is, as a being with certain worth or dignity. This worth in the first instance is related to his willingness to risk his life in a struggle over pure prestige" (1992, xx). In other words, it is this desire to recognize their humanness that propels all forms of mortal battles. As the world progresses or evolves, it is obvious that this desire to be recognized has taken various forms and shapes. One may argue that 'the desire for recognition' is an unfamiliar concept, but for Fukuyama the desire for recognition is as old as Western political philosophy and represents the nature of human personality. This grants us insight into the nature of international politics or geopolitics. This desire for recognition may have been satisfied in liberal democracy, as argued by Fukuyama, but that will be within a liberal democratic state. I would like to argue that this same desire for recognition is what propels geopolitics. Countries still desire to be recognized by other countries. The idea of imperialism, neocolonialism, developed world, underdeveloped world, and the likes are all traceable to this desire to be recognized. The relationship that exists at individual level naturally replicates at the state level, and at geopolitical level. This concept is illuminating and helpful in understanding the workings of the contemporary world and international politics.

In our contemporary time, this desire for recognition has taken an entirely different form. It is technological development race or competition. Wu argues that geopolitics and technology are increasingly intertwined and, as a result, technology is now highly politicized and has become a more prominent element of great power rivalry (2020, 100). It is on this note that I will like to posit that the West continue to place itself in the position of epistemic hegemony. Logically, it is not out of place to argue that the Western

acceptance of African epistemic tradition will change the narrative in favor of Africa or probably place Africa as a close rival. Thus, Africa's quest for epistemic liberation is an exclusive African affair. Eurocentric technologies pushed down to Africa are a continuation of Western epistemic dominance, which tends to address their desire for recognition. With the advent of the fourth industrial revolution, there is a clarion call for African contribution in technology development. Total dependence on Eurocentric technology will continue to alienate and impoverish Africa. This does not imply that Africa have not benefited from Euro-American developed technology, rather there is need for an Africanized technology to complement that of the West. In geopolitics, there is a need for Africa to have what it can boast of or give out at the global space. In all, there is a need for the West to bring what they have from place to space, just as Africa is expected to do the same.

Africa and the Fourth Industrial Revolution

Africa cannot do much in this era of fourth industrial revolution if all her scientific research and innovations are tailored to suit Euro-American prototype. Following Euro-American prototype at best will make Africa second best. This will perpetually keep Africa in the shadow of the West. It seems Africa has no place in geopolitics or, should I say that the Euro-American structure in geopolitics was created to exclude Africa. We are faced with these questions; how is Africa going to be included? Who is going to include Africa? The one who excluded her from the beginning or someone else? From the foregoing, I want to assert that it is the sole responsibility of Africa to place itself in the global epistemic map. This will lead us to the question of 'how'? How is Africa going to place itself in the global epistemic map?

But before I delve into this 'how' question we need to consider another important question. The question on the appropriateness of technology developed with values and interests of Western societies to that of African users; the challenge of socio-economic and political disruption that comes with it. In addressing this question lies the answer to our initial 'how' question. In the words of Birhane, "Certain matters that are considered critical problems in some societies may not be considered so in other societies. Solutions devised in one culture may not transfer well to another" (2020, 395). The importation of technologies associated with fourth industrial revolution in Africa and Africa's overtly acceptance of such technology without critical assessment and high consideration on its transferability constitutes a great obstacle that hinders development in Africa. Birhane argues that Western developed AI driven solution to social problems is not only unfit for African problems, that its invasion impoverishes development of local products while also leaving the

continent dependent on Western software and infrastructure. Using Nigeria as an example, I would like to point out the negative impact of import dependency on Africa, both in the area of technology and other sectors. In the area of agriculture, over 80% of rice consumed in Nigeria were imported in the past. Locally produced rice were seen as products of low quality and can only be taken by the poorest. For years, rice production in Nigeria suffered retrogression. Today with the ban on importation of rice in Nigeria, locally produced rice have advanced to the extent that they can favorably compete with what is obtainable anywhere in the world. Importation of Eurocentric technology in Africa does not only impoverish Africa, it robs her of indigenous technological innovation.

Most of the technologies associated with the fourth industrial revolution are Eurocentric. The more Africa imports or are forced to accept these technologies, the more they promote and advance Eurocentrism. In advancing Eurocentrism, there is cultural and social disruption of indigenous African heritage. This promotes Euro-American hegemony. In this era of the fourth industrial revolution certain crucial issues across the continent of Africa, especially in the area of agriculture, automotive, manufacturing, transportation and healthcare, can be better addressed with the aid of locally developed technology. Africa needs to understand that Europe and America cannot help Africa by reason of historical past, as it is to their advantage that Africa is still where it is today. If we agree with Fukuyama that the desire for recognition is coeval with human nature, then it is clearer to us why Euro-American epistemic tradition will want to perpetuate itself in the place of hegemony.

Conclusion

In this paper, I have endeavored to establish that struggle for recognition is coeval with individual human nature. It is also operational at societal and geopolitical level. I have also pointed out that the age-long Western hegemony is a product of this struggle for recognition. This Western hegemony was achieved through knowledge production. More so, Eurocentrism has taken various forms and shapes, and has continued to thrive progressively. In this era of the fourth industrial revolution, Euro-American epistemic paradigm has continued to perpetuate itself in the position of hegemony. The influx of Western developed technology to Africa is a continuation of Western dominance. There is already a socio-cultural disruption going on in Africa, which, if not properly addressed, will widen the epistemic gap and possibly make it a near-impossible problem to be addressed. On this note, I advocate that in this era of the fourth industrial revolution, the onus lies on Africa to challenge this status quo. This can be achieved by systemizing African indigenous technology and Africanizing Western imported technology.

Relevant Literature

1. AFRICAN DEVELOPMENT BANK. "Unlocking the Potential of Fourth Industrial Revolution in Africa," [Study Report], 2019. Web.
2. BIRHANE, Abeba. "Algorithmic Colonization of Africa," [Scripted], pp389-409 2020. Vol 17. No 2. Web.
3. CHIMAKONAM, O Jonathan. (2017) "African Philosophy and Global Epistemic Injustice" [Journal of Global Ethics], pp120-137 2017. Vol 13. No 2. Web.
4. ____. "Conversational Philosophy as a New School of Thought in African Philosophy: A Conversation with Bruce Janz on The Concept of Philosophical Space," [Confluence], pp9-40, 2015. Vol 3. Web.
5. DOSHI, Rush, "The United States, China, and the Contest for the Fourth Industrial Revolution," Prepared Statement Presented before The United States Senate Committee on Commerce, Science, and Transportation, Subcommittee on Security July 30, 2020 Web.
6. TIH, Felix, "Madagascar Slams WHO for not endorsing its herbal cure" N. P. May 11th 2020 Retrieved August 10th, 2021 Web.
7. FUKUYAMA, Francis [The End of History and the last man], 1992. The Free Press: New York. Paperback.
8. HEGEL, Georg W. F. [The Philosophy of History], 1956. Sibree, J. (trans.) Dover Publications Inc.: New York. paperback.
9. GROSFOGUEL, Ramon. "The Epistemic Decolonial Turn: Beyond Political-Economy Paradigms," [Cultural Studies], pp.211-223 2007. Vol 21. Issue 2-3. Web.
10. HOUNTONJI, Paulin. "Scientific Dependence in Africa Today", [Research in African Literatures], pp.5-15 1990. Vol 12. No 3. Web.
11. KOJEVE, Alexandre. [Introduction to the Reading of Hegel: Lectures on the Phenomenology of Spirit, assembled by Queneau, Raymond, Bloom, Allen (ed.), Nichols, H. James JR. (trans.) Cornell], 1969. University Press: London. Paperback.
12. LAMOLA, John M. "Africa in the Fourth Industrial Revolution: A status question is from the cultural to phenomenological," [African Values, Ethics and Technology, Beatrice OKYERE-MANU ed.], 2020. Palgrave Macillan: London. Web.
13. LASSWELL, Harold D. [Politics: Who Gets What, When, How], 1936. Whittlesey House: New York. Paperback.
14. MILLER, Dan. "Natural Language: The User Interface for the Fourth Industrial Revolution"[Opus Research Report], 2016. Web.
15. PASSI, Anssi. "Academic Capitalism and Geopolitics of Knowledge" [Companion to Political Geography, Agnew, John n.d.n. eds.], 2015. Wiley-Blackwell: New Jersey. Paperback.

16. REAGAN, James R. & SINGH, Madhusudan. [Management 4.0: Cases and Methods for the 4th Industrial Revolution], 2020. Springer Nature: Singapore. Paperback.
17. SCHWAB, Klaus. [The Fourth Industrial Revolution], 2016. World Economic Forum: Geneva. Web.
18. WU, Xiangning. "Technology, Power, and Uncontrolled Great Power Strategic Competition between China and the United States," [China International Strategy Review], pp 99-119 2020. Vol 2. Web.

The Fourth Industrial Revolution: Inclusiveness, Affordability, Cultural Identity, and Ethical Orientation

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Abstract
Discussions on the impact and future directions of technology often proceed from an empirical point of view that seems to presume that the ebb and flow of technological developments is beyond the control of humankind, so that all that humanity can do is adjust to it. However, such an approach easily neglects several crucial normative considerations that could enhance the standing of individual human beings and whole communities as rational users of technology rather than its slaves. Besides, more often than not, technological products are designed in ways that neglect the needs of persons with disabilities, thereby perpetuating their exclusion from society. Consequently, this article proposes four normative considerations to guide the initiatives of African societies in their deployment of the technologies of the Fourth Industrial Revolution, namely, inclusiveness to meet the needs of all human beings, affordability to bridge the digital divide, respect for cultural identity to guard against cultural imperialism, and an ethical orientation as the over-arching guide to building a truly human society.
Keywords: Fourth Industrial Revolution, Persons with Disabilities, Inclusiveness, Digital Divide, Cultural Identity, Ethical Orientation

Introduction

"Welcome to tomorrow!" and "tomorrow is already here!" are popular phrases often used in the context of the Fourth Industrial revolution ("4IR"). Even at the December 2020 Sight Tech global Conference, a forum on creating technological accessibility for people with diverse visual impairments, one of the plenary sessions was titled "Our AI future is already here" (SIGHT TECH GLOBAL 2020, N.P). However, it is now commonly assumed that the ebb and flow of technological developments is beyond the control of humankind, so that all that humanity can do is adjust to it. In what follows, I advance the view that humankind ought to ensure that 4IR is guided by a value system that

places humankind at the centre of this technological revolution as an agent rather than a victim.

Paul Donovan (2021, 20) summarises the past three industrial revolutions as (1) steam power, (2) electric power, and (3) computer power. Nicholas Johnson and Brendan Markey-Towler (2021, 19-26) speak of the four revolutions as the industrial revolution, the technological revolution, the digital revolution, and the fourth industrial revolution. They go on to note that the Fourth Industrial Revolution (4IR) is the current period of economic transition since the mid-2000s, characterized by a fusion of new digital technologies, rooted in advances from the Digital Revolution, with technological applications in the physical and biological domains (JOHNSON and MARKEY-TOWLER 2021, 25). Nevertheless, Donovan (2021) notes that the phrase "industrial revolution" entered common usage long after the first industrial revolution had begun. Karl Marx's collaborator on *The Communist Manifesto*, Frederick Engels, used the phrase in German in the 1840s. The phrase was first used in English by Arnold Toynbee in 1882 (DONOVAN 2021, 20). This points to the fact that human beings often name something quite a while after they have experienced it, and the same has been true of 4IR, although we may have named it earlier than the first three because we are now more used to the idea of industrial revolutions than those who went before us were.

Erik Brynjolfsson and Andrew McAfee of the College of Science and Engineering, formerly Minnesota Institute of Technology (MIT), refer to 4IR as the Second Machine Age ("2MA"). According to them, while the first machine age was about the automation of manual labor and physical strength, the 2MA technological progress in digital hardware, software and networks is about the automation of knowledge (cited in GLEASON 2018, 2). At the core of the automation of knowledge is artificial intelligence (AI). Johnson and Markey-Towler explain: "Artificial intelligence, especially when endowed with machine learning algorithms, is a technology which seeks to mimic the functioning of the human mind, and which can therefore mimic human action guided by a process that mimics human thought" (JOHNSON and MARKEY-TOWLER 2021, 100). Johnson and Markey-Towler further observe that artificial intelligence has greatly enhanced the use of robots:

> …, the 4IR moves the goalposts from automation to smartization, whereby intelligently programmed software and robots are able to collect new data during the regular course of their operation, share it with other approved devices on the network, analyse the data, and use the conclusions to update their course of action. The 4IR took "dumb" autonomous machine and made them "smart." This step was essential to the development of technological marvels such as self-driving cars and trucks and next-

> generation industrial robotics (…). (JOHNSON and MARKEY-TOWLER 2021, 115)

During the Sight Tech Global Conference, which I referred to at the beginning of this article, Kai-Fu Lee, one of the world's top scientists and top investors in the field of artificial intelligence and author of [AI Superpowers: China Silicon Valley and the New World Order] (2018), observed that the current generation's breakthrough in a type of AI called neural nets, sometimes referred to as deep learning, has enabled remarkable advances in areas such as computer vision and natural language processing. He went on to state that today's AI capabilities are so great in this raw form that what is needed now are the engineers, and, most importantly, the data to make the most of all the possibilities. He explained: "… computers … can see and hear at the same level as people now. So, with speech recognition for machine translation and for object recognition, AI is now at about the same level as humans. And AI is improving rapidly, based on its ability to take a huge amount of data whether it's spoken language or recorded videos to really train itself to do better and better. So over time, it will be a better see-er and hear-er than humans." Referring to what he calls the third wave of artificial intelligence as perception AI, Lee spoke of "… extending and expanding this power throughout our lived environment, digitizing the world around us through the proliferation of sensors and smart devices. These devices are turning our physical world into digital data that can be analyzed and optimized by deep learning algorithms" (DESMOND and LEE 2020, N.P).

Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, formerly the European Management Forum, lists emerging technology breakthroughs in fields such as artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing, among the things that will drastically change our lives in 4IR (SCHWAB 2016).

Indeed, the lives of the peoples of Africa are already being touched by 4IR in ways that many of them are yet to perceive - their smartphones, with their "Location" function on, are beaming data about their movements to networks, and the data are then sold to high tech transport companies desperate to gather information about traffic flow in cities; many of them unwittingly allow phone apps to access their microphones and cameras, with the real possibility of their conversations and actions being monitored; their emails and social media posts are being monitored for information about them that is sold to marketers, advertisers and politicians who use it for targeted

advertisements; their faces are increasingly being scanned by cameras connected to face-recognition software ostensibly to enhance security, but with the real possibility of surveillance for purposes unknown to them. What is likely to be more alarming to many, however, is the fact that the combination of artificial intelligence and robotics supported by high speed online connectivity is threatening to render jobless those without requisite new skills in a few years time (SCHWAB 2016, N.P; DONOVAN 2021, 22-27).

Rob Floyd (2021, N.P) informs us that the African Centre for Economic Transformation, working with other institutional partners and nearly 40 data scientists and machine learning experts from around the globe, recently completed the continent's first "Artificial Intelligence Challenge" ostensibly to help predict what infrastructure Africa will need in the future. According to Floyd, the exercise sought to identify machine learning tools and approaches that can inform policy decisions. The data scientists created models and designed methodologies that could help determine what infrastructure to build, where to build it, and what factors will have long-term economic impacts on the continent.

As intimated in my opening paragraph, it is now assumed that all that humans can do in the face of new technologies is to adjust to them. Thus Schwab (2016, N.P) talks of "the inexorable shift from simple digitization (the Third Industrial Revolution) to innovation based on combinations of technologies (the Fourth Industrial Revolution) ". Nevertheless, such an approach easily neglects several normative considerations requisite for enhancing the standing of individual human beings and whole communities as rational users of technology rather than its slaves. These considerations are crucial in 4IR, whose advent has implications on weighty moral issues such as privacy, respect for the integrity of the human person, personal choice, and the right to cultural identity.

Consequently, in what follows, I propose four normative considerations that, in my view, ought to guide the initiatives of African societies in their deployment of 4IR technologies, namely, inclusiveness to meet the needs of all human beings, affordability to bridge the digital divide, respect for the right to cultural identity to guard against cultural imperialism, and an ethical orientation as the over-arching guide to building a truly human society.

Inclusiveness to Meet the Needs of all Human Beings

It is a truism to state that the purpose of technological innovations is to meet human needs, whether material, physical, physiological, psychological or social. Thus, any technological innovation that impoverishes human life, as nuclear bombs, landmines, or the wide range of chemical and biological weapons threaten to do, is a non-living monster invented by a human being

with monstrous intentions. This simple truth is often bypassed when discussions are cast in terms of the need to respond to technological advancements rather than being framed in terms of the need to identify ways of ensuring that users of technology give direction to such advancements. The approach that is beholden to technological advancement is sometimes summed up in the saying that if we do not adapt to change, change will sweep us along with it.

Tragically, in our time, dominated by capitalist values with their highly individualist orientation, human need is often narrowly viewed in terms of physical necessities or physical cravings, with formal education being conceptualised as the path to meeting them. this explains the growing popularity of the neoliberal notion of "market-driven courses" that is threatening to reduce education systems around the world to handmaids of the market rather than tools for moulding the whole person (SANTAMARÍA 2019, N.P). More crucially, the values of the so-called economic liberalism currently driving 4IR are contrary to the communalistic values that the vast proportion of African peoples embrace, variously expressed by the saying "I am because we are, and because we are, therefore I am" (MBITI 1969, 141), and by the Kiswahili saying that "*Mtu ni watu*", which literally translates as "A person is people" (ODUOR 2016/2017). Similarly, the Shona say that "*munhu munhu muvanhu*", while the Ndebele and Zulu say that "*umuntu ngumuntu ngabantu*", both of which can be rendered as "A person is a person through other persons" (MANGENA 2014, 36). Thus, in the African context, the meeting of human needs includes ensuring that the individual drinks deeply from the well of communal living. Consequently, any technology that diminishes the quantity and quality of interaction among family members, colleagues or friends by affording individuals hours of solitary enjoyment, as is the case with social media currently, is a barrier to the meeting of a crucial human need.

Another pertinent concern is the fact that the gender disparity which characterised the first three industrial revolutions is threatening to worm its way into the fourth. As Gleasen (2018, 5-6) explains, "Females are less likely to have digital literacy, which means they will be less likely to take advantage of technological opportunities. Even for those who are fortunate enough to be participating in the technology-related workforce, women are significantly underrepresented. …, the reasons [for this] relate to a lack of mentors, a lack of female role models, gender bias, unequal growth opportunities compared to men, and unequal pay for the same skills."

There is also the urgent need to ensure that the full inclusion of persons with disabilities in society is promoted in 4IR. According to the United

Nations Convention on the Rights of Persons with Disabilities (CRPD), "Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments, which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others" (UNITED NATIONS 2006, Article 1). A major social barrier that persons with disabilities confront on a daily basis is prejudice - the irrational, albeit tacit, discrimination of members of this group on the basis of their sensory, motor or cognitive impairments; and this discrimination is manifested in government planning, decisions by leaders of private businesses, and in one-to-one interactions, all of which results in the marginalisation or outright exclusion of such persons from the life of society. Thus highly qualified persons with disabilities often miss employment due to the prejudice of those responsible for hiring, who will often not even bother to find out how such persons cope with the limitations arising from their disabilities. Donovan highlights the deleterious effects of any prejudice on the economy as follows:

> Why is prejudice so bad for the economy? Prejudice throws away skilled workers for no good reason. Prejudice stops workers from moving to better jobs for no good reason. Prejudice prevents good decision-making. Prejudice weakens profits and economic strength. Prejudice wastes workers' talents. Companies and countries succeed if they make the most of their workers' talents. (DONOVAN 2021, 1)

Indeed, due to prejudice, physical and social environments are regularly designed without considering the needs of persons with disabilities. According to the World Health Organisation's *World Report on Disability* (2011)[1], more than one billion people in the world lived with some form of disability, of whom nearly 200 million experienced considerable difficulties in functioning. The report indicated that in the years ahead, disability would be an even greater concern because its prevalence was on the rise due to ageing populations and the higher risk of disability in older people, as well as the global increase in chronic health conditions such as diabetes, cardiovascular disease, cancer and mental health disorders. The report went on to observe that persons with disabilities have poorer health outcomes, lower education achievements, less economic participation and higher rates of poverty than

[1] I cite this 2011 WHO report because there has been no other comprehensive report on the issue after it - which itself highlights the marginality of disability in global discourse.

people without disabilities. This is partly because they experience barriers in accessing services such as health, education, employment, transport and information (WORLD HEALTH ORGANISATION 2011, N.P).

To mitigate the disempowering effects of disability-unfriendly physical and social environments that perpetuate exclusion, the UN Convention on the Rights of Persons with Disabilities (CRPD) stipulates the Principle of Universal Design, which it defines as "the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. Nevertheless, universal design does not exclude assistive devices for particular groups of persons with disabilities where these are needed" (UNITED NATIONS 2006, Article 2).

Members of the community of persons with disabilities often illustrate the principle of universal design stipulated in the CRPD by comparing a ramp and a staircase: if you only erect a staircase in a building, only persons with two working feet can go upstairs unaided; but if you build a ramp instead, the wheelchair users will have equal access to the building, so the ramp is more inclusive than the stairs. In the era of 4IR, we need to act as builders of ramps rather than erectors of staircases in all our technological innovations to ensure that we break the disability-poverty symbiosis. This is in line with the CRPD, which is a significant move away from the medical model of conceptualising disability (which views persons with disabilities as objects of charity) towards a social model (which conceptualises them as bearers of rights).

It is important to bear in mind that universal design of ICT products (which are the gateways to 4IR technologies) is cost-effective. For example, when web content is designed from the start to be accessible to persons with disabilities, the expected costs are only 1 to 2% of the costs of the overall web design project (LAZAR and STEIN 2017, 1), whereas the cost of designing and manufacturing separate technologies to mediate the access is much higher. Yet when persons with disabilities are denied access to ICT, they are also excluded from enjoying freedom of expression, freedom of information, political participation, civic engagement, inclusive education, the right to access the highest level of scientific and technological information, and participation in social and cultural opportunities (LAZAR & STEIN 2017, 3-4).

There have been amazing strides in what in the digital technology world is called 'accessibility' That is, in-built features that enable people with a variety of disabilities to use technology. The enhanced "hearing" and "seeing" capabilities of computers in the advent of AI that Kai-fu Lee, earlier

cited, speaks about have enhanced the effectiveness of speech recognition software, enabling persons who lack the use of their hands to type using their voices (JOHNSON & MARKEY-TOWLER 2021, 87). Similarly, text to speech recognition software has resulted in screen-reading applications that enable persons with total visual disability to get audio output from devices such as computers, mobile phones, thermometers, blood pressure machines and weighing machines, thus enabling them to use such devices without sighted assistance; conversion of text on the screen to virtual Braille on a panel enables persons who are deaf-blind to use computers unaided; magnification technology has come in handy for persons with low vision; captioning has made information relayed through sound accessible to persons who are deaf or hard of hearing. Many of these 3IR innovations are now augmented by AI to produce hitherto unimaginable accessibility to technology by persons with disabilities, particularly in the use of computers and smartphones. Universal design of 4IR products would greatly contribute to promoting the inclusion of persons with disabilities in society, as they would, thereby, be able to pursue independent living, formal education, commerce and employment on an equal basis with others.

It is also noteworthy that universal design is not only beneficial to persons with disabilities, but also to people who are able-bodied. To give a few examples, just as a ramp is greatly beneficial to those who are temporarily ill-disposed and need to use wheelchairs for a limited period of time, so also magnification software gives those with sight wider options for the layout of documents that they wish to read, speech-recognition software enables those who find it difficult to type using their fingers to avoid doing so, while screen-reading software gives the sighted the option of listening to text instead of looking at it. Similarly, with the use of appropriate icons and voice output, there is no reason why an able-bodied peasant farmer who does not have the benefit of literacy cannot use voice commands on a smartphone to search the web for the best prices for his or her produce or to dictate text messages to his or her friends; he or she can also send voice messages to his or her son or daughter and receive replies through the same channel.

A crucial aspect of human welfare is personal liberty, entailing rights such as those of free association, movement, expression and privacy. Yet 4IR is eroding these very liberties through surveillance: smartphones now easily "hear" and "see" much more than their users intend or know. What is more, governments are consolidating various databases (such as those on health insurance, births and deaths, voters' lists, and criminal records) into single super-databases, so that at the click of a button those with access can view a citizen's information in astoundingly fine detail that can be used against him or her. Thus, in the run-up to the 2020 US elections, some US citizens wrote a

parody of the famous American civil war-period song "His Truth Goes Marching On", part of which stated:

> Our right to privacy is gone, devices are the spies.
> For government surveillance those are now the ears and eyes.
> They use the corporate data, no subpoenas, no surprise,
> And still we don't catch on.

All this calls to mind George Orwell's dystopian novel, *1984*, in which the single party, embodied by the mythical "Big Brother", deploys 4IR-type technologies to monitor not only the people's actions, but also their thoughts (ORWELL 1961 [1949]). Yet we must refuse to sink into helplessness, because governments and big corporates cannot withstand concerted, co-ordinated pressure by citizens or consumers. For example, in early 2021, due to the mass exit of users, the tech corporate which owns a leading chat platform had to temporarily halt its plans to avail users' data to advertisers, thereby confirming the diagnosis of the sixteenth-century French jurist and political philosopher, Étienne de la Boétie, that a tyrant cannot retain his or her position if the subjects cease to serve him or her: "I do not ask that you place hands upon the tyrant to topple him over, but simply that you support him no longer; then you will behold him, like a great Colossus whose pedestal has been pulled away, fall of his own weight and break into pieces" (LA BOÉTIE 2002, 48-49).

In sum, the peoples of Africa must not see themselves as passive recipients of the technologies of 4IR, but rather as users and innovators of such technologies, with their needs clearly in view (GYEKYE 2013, 48-63). Already, during the Third Industrial Revolution, technologically knowledgeable Africans undertook innovations to meet the needs of their peoples. For example, my own country, Kenya, won itself a place in the global digital innovation map by inventing the first mobile money transfer service called M-Pesa. Now with 4IR, there is almost infinite room to design apps to meet the needs of farmers, traders, mechanics, and the wide array of professions, and to promote the inclusion of persons with disabilities, as well as others with diverse limitations and preferences not categorised as disabilities (illiteracy, for example), in all these endeavours through universal design.

Affordability to Bridge the Digital Divide

Rashied and Bhamjee (2020) observe that industrialisation in 4IR could easily continue along the path of coloniality, in which the wealthy countries of the

Northern hemisphere exploit the resources of countries in the South, but that it could also result in some of the wealthier countries of the Global South exploiting their poorer counterparts. During the Third Industrial Revolution, the inequality between the wealthy countries in the North and the poor ones in the South was regularly referred to as "the digital divide" - a divide that is already finding its way into 4IR.

As Schwab (2016, N.P) observes, "To date, those who have gained the most from it [the Fourth Industrial Revolution] have been consumers able to afford and access the digital world; …" The *Digital Economy Report 2019*, released by the UN Conference on Trade and Development highlighted the disproportionate concentration of the digital economy in the United States and China, with the rest of the world trailing considerably, especially countries in Africa and Latin America. The United States and China account for 90% of the market capitalization value of the world's 70 largest digital platforms, over 75% of the cloud computing market, 75% of all patents related to blockchain technologies, and 50% of global spending on the Internet of Things. The report predicts that, under current regulations and policies, this trajectory is likely to continue, contributing to increasing inequality (cited in TANGUAY 2021, N.P). Yet, perhaps even more disturbing, is the digital divide right inside each of our countries in Africa, where the middle class enjoys virtually all the benefits of 4IR technologies that their counterparts in the affluent West and East enjoy, while the vast majority of their compatriots still grapple with lack of basic amenities such as access to electric power so that for them the issue of entering the digital world does not even arise. Thus, as Donovan (2021) observes, there are many people who cannot afford a smartphone and a data plan to enjoy the benefits of 4IR, so that "The democratisation of communication only applies to those above a certain income level" (DONOVAN 2021, 66).

It is therefore urgent that during 4IR, the digital divide is bridged through affordable technology, thereby forestalling the perpetuation of marginalisation based on people's material circumstances. Happily, the Third Industrial Revolution, which commenced with intense protectionism in the development and sale of computer software, winded up with an explosion of open-source software, enabling economically disadvantaged users to simply download and use open access word processors, spreadsheets, presentation applications, among others. In academia, this saw the proliferation of open access journals that even forced most of the leading publishing firms to set up open-access departments to ensure they remained relevant. This trend ought to be encouraged as we enter 4IR. On this point, H. Odera Oruka's concept of the human minimum - the conviction that no human being ought to be left to suffer certain levels of lack (ORUKA 1997, 131-132) - can be re-modelled in

the light of the 4IR digital divide. In this context, the ethical principle of the human minimum would affirm that humanity ought not to be contented with a situation in which residents of the North enjoy the benefits of 4IR while those of the South continue to live below the subsistence level where even electrical power is a pipedream, so that the benefits of a highly digitised world are extremely hard for them to imagine. Similarly, the middle classes in the South ought not to continue to enjoy the benefits of 4IR while their compatriots struggle to eke out a living using inefficient technologies in rural villages and urban informal settlements.

A less well-known but debilitating digital divide is that between people who are able-bodied and those with disabilities. This is aggravated by the exorbitant cost of adaptive ICT, that is, software and hardware specifically designed to mitigate various sensory, motor and cognitive impairments. In his Foreword to the *World Report on Disability* (WORLD HEALTH ORGANISATION 2011) earlier cited, Stephen W. Hawking, renowned astrophysicist who lived with motor neuron disease most of his adult life, wrote:

> I have benefitted from access to first class medical care. I rely on a team of personal assistants who make it possible for me to live and work in comfort and dignity. My house and my workplace have been made accessible for me. Computer experts have supported me with an assisted communication system and a speech synthesizer which allow me to compose lectures and papers, and to communicate with different audiences. …. My success in theoretical physics has ensured that I am supported to live a worthwhile life. It is very clear that the majority of people with disabilities in the world have an extremely difficult time with everyday survival, let alone productive employment and personal fulfilment. (HAWKING 2011, p.ix)

Yet many persons with disabilities in African countries and elsewhere need facilities that cost much less than what Steven Hawking required for them to lead highly productive lives, and many of the solutions they need lie in promoting affordability of the technologies of the third and fourth industrial revolutions. Already, several persons with disabilities in many African countries have excelled in professions such as law, academics and computer programming due to accessible computer resources, but many more still languish in poverty simply because of lacking affordable adaptive ICT products that would enable them to engage in self-improvement through formal education, employment and entrepreneurship.

Respect for the Right to Cultural Identity to Guard against Cultural Imperialism

Disregard for factors such as cultural identity and political convictions is often reflected in the very design of 4IR products themselves (TANGUAY 2021; see also GYEKYE 2013, 48-63). For example, machine learning algorithms, although designed to help in problem-solving and decision-making, are vulnerable to biases and errors arising either from their creators or from the datasets used to train the systems themselves. Thus Amazon's time-and resource-intensive effort to build an AI recruitment tool was shot through with bias against women. Engineers reportedly attributed this bias to the AI combing through CVs submitted to the company over a 10-year period, most of which were submitted by men. Amazon had to abandon the system on the grounds that despite making edits to it, there was no guarantee that it no longer discriminated against female candidates (TANGUAY 2021).

It is heartening that consumers can now boycott companies that do not agree with their political positions: apps even suggest alternative products with better scores (DONOVAN 2021, 69). However, "With an app, the opinion that works out the details is someone else's opinion. …. If the shopper has different priorities to the app designer, they may spend in areas they do not actually support" (DONOVAN 2021, 69). In addition, although it is often claimed that the communication technologies have democratized communication, "It is true that views can be posted. But at the same time, the process has given more editorial control to the platforms on which views are posted. Not everyone on social media is created equal. Algorithms give preference to some social-media users. They also will censor others. Government censorship was commonplace 300 years ago. The private-sector equivalent is the demonetisation, downgrading or banning of published content" (DONOVAN 2021, 66).

Within the African context, Western hegemony compounds the challenges described in the foregoing two paragraphs. The current process of globalization, heavily influenced by this hegemony, espouses an ethnically-blind vision of society in line with the Western liberal democratic tradition. Yet as the growing literature on communalism and communitarianism illustrates, the liberal democratic vision of ethnically-blind societies violates the rights of individuals and groups to identify themselves with particular cultural formations. As Okondo (1964, 37) noted, just as it is necessary for one to accept and to have a degree of pride in one's ancestors, so it is desirable to draw strength from association with an ethnic group whose traditions enrich one's life. As the Canadian philosopher Charles Taylor (1994, 25) observes, a person or group of people can suffer real damage if the people around them mirror back to them a demeaning picture of themselves, imprisoning them in a

false, distorted and reduced mode of being. Indeed, ethnic minorities in several African countries have suffered decades of social, political and economic marginalisation, many living in countries whose very names (such as Uganda and Botswana) signify the privileged positions of the dominant cultural groups in them (ODUOR 2018).

The liberal ethnically-blind socio-political vision also contravenes the International Covenant on Civil and Political Rights, which stipulates that ethnic minorities are entitled to collective rights:

> In those states in which ethnic, religious or linguistic minorities exist, persons belonging to such minorities shall not be denied the right, in community with the other members of their group, to enjoy their own culture, to profess and practise their own religion, or to use their own language. (UNITED NATIONS 1966, Art.27)

Yet, cultural domination is becoming equally, or more pronounced, within the context of globalisation, where the dominant Western culture is putting non-dominant non-Western cultures under great pressure to allow themselves to be assimilated in the global (read "largely Western") cultural pool on the presumption that they are inferior to Western culture. As Lamola (2021b) observes, "An authentic global culture should surely be a fusion of contributions from all 'Civilisations', in which Western agonizations about the nature and future of humanity is only taken into account as merely one among several."

With regard to the deleterious impact of foreign cultural domination on Africans within the context of 4IR products, Lamola (2021a) points out that "… the scientific paradigm that is systematically inaugurating this revolution in the re-engineering of the human, the digitalisation of human existence and modes of sociality, is driven by culturo-epistemic presuppositions that are exclusively and ethnocentrically informed by the Western intellectual heritage with its self-endowed belief in its universality and supremacy." According to Lamola (2021b), 4IR is primarily inspired by a combination of the logic of "digitized reason" and a neo-imperialism of tech-corporatism, both of which are manifestations of a postmodernism of the Western intellectual heritage. Lamola points out that all this negatively and palpably affects the African end-user as follows:

> As the human user is 'forced' to adapt to using a strange and complicated device, an asymmetry of influence occurs between the user and the technological device, in which the latter assumes greater ontic-ontological influence. The culturally disadvantaged user is thus simultaneously

> mesmerised and alienated by an object that imposes itself as instrumental for the efficiencies of her life; during the same experience she must align her way of doing things to the intricacies of the operation of this device or machine, as well as to the social role it is cast to serve in her life. (LAMOLA 2021a)

There is, therefore, an urgent need to ensure that the choice of 4IR technologies deployed in African societies takes cognisance of the worldviews of the said societies instead of subjecting them to a homogeneity created by their erstwhile colonisers. It cannot be gainsaid that 4IR provides an unprecedented variety of choices of technologies, which should make it practicable to identify those that are best suited to specific cultural contexts. Yet the range of choices is largely determined by the Western corporations that produce the bulk of these technologies, thereby perpetuating the Western cultural hegemony. Consequently, it behoves Africans to diligently engage in decolonization in their theorizing and innovations on an ongoing basis.

Ethical Orientation as the Over-arching Guide to Building a Truly Human Society

I use "ethics" here as a synonym of "morality" to refer to the practice of evaluating human conduct as either right or wrong, and human traits of character as either virtuous or vicious. Schwab (2016, N.P) observes that the fourth industrial revolution is characterized by a fusion of technologies that is blurring the lines between the physical, digital and biological spheres. He goes on to write: "The Fourth Industrial Revolution, …, will change not only what we do but also who we are. It will affect our identity and all the issues associated with it: our sense of privacy, our notions of ownership, our consumption patterns, the time we devote to work and leisure, and how we develop our careers, cultivate our skills, meet people, and nurture relationships. It is already changing our health and leading to a 'quantified' self, and, sooner than we think, it may lead to human augmentation. The list is endless because it is bound only by our imagination." Yet that imagination can, and ought to be, moral. Even Schwab (2016), who is a 4IR enthusiast, observes that "…the revolutions occurring in biotechnology and AI, which are redefining what it means to be human by pushing back the current thresholds of life span, health, cognition, and capabilities, will compel us to redefine our moral and ethical boundaries." However, I hold the view that the issue is more that of the clarification and re-affirmation of our moral valuesthan that of a redefinition of our moral boundaries as Schwab suggests. This is due to the fact that redefining our moral boundaries simply because we are confronted by new technologies seems to me to imply that the technologies determine our

moral boundaries, in which case our redefinition of the boundaries is, by and large, superfluous.

With regard to some of the pertinent moral questions arising within the context of 4IR, Tanguay writes:

> New technologies are … raising perplexing moral questions that most of us have never contemplated. Should your driverless car value your life over that of a pedestrian? Should we legalize predictive policing based on AI? Should gene editing be made legal to create "designer babies"? If you could undertake a little gene editing to increase your child's IQ, would you do it? What if it was possible to patent a human *gene?* (TANGUAY 2021)

In addition, pertinent moral issues arise relating to the use of various digital platforms for commerce and communication, some owned by governments, and others by private entities:

> Ethical issues arise, …, when third-party institutions and organisations choose to interfere in the digital flows of information. For example, a government may believe it has the right to control trade flows, but can the same reasoning be applied to information flows? Another grey area arises when private, unelected companies are the third-party institutions which manage a private platform through which users become de facto producers and consumers of information and news updates. These platform companies derive enormous market power from their ability to determine how producers and consumers coordinate to find each other and negotiate deals (…), what terms and conditions of entry to the platform marketplace are imposed, and whether there is a participation fee. (JOHNSON and MARKEY-TOWLER 2021, 89)

The situation described in the previous paragraph is aggravated by the fact that we live in the era of fake news, demanding more effort and time to verify what we read, view and hear. Donovan explains:

> A viral message spreads out faster and further if it is "fake news". …. Analysis of 12 years of Twitter activity shows that "fake news" is around 70% more likely to be retweeted than actual news. …. And "fake news" is spread significantly faster than the truth. This is particularly true of fake

> political "news". Fake political "news" will reach 20,000 people three times faster than a true political story reaches 10,000 people. …. "Fake news" can be put into sensational language. This becomes what is known as "click bait". If the author is not worried about the truth, it is easy to sensationalise the story. That attracts readers and speeds up the sharing of the story. (DONOVAN 2021, 63)

Yet fake news has become such a major problem because of the lack of sound ethical orientation among those who produce it.

Following ordinary usage, I make the distinction between "the earth" and "the world", the former being the physical environment on the planet as a whole devoid of human action, the latter the result of human action on both the physical environment and the conceptual orientation that guides the deliberate, human shaping of both the physical and social realms. Central to this conceptual framework has always been morality - the conviction that our actions and traits of character ought to be restrained by considerations of the welfare of people around us. Entering into 4IR without commitment to maintaining a sound orientation of human values with morality at its core exposes us to living in a rudderless technological space rather than in the world (GYEKYE 2013, 48-63). This in turn exposes the succeeding generations of African peoples to the grave danger of having no substantial normative grounding, which would spell doom for both individuals and societies. All this points to the urgent need to integrate values such as equity, diversity and inclusion into programme design and implementation (TANGUAY 2021).

In view of the kinds of changes that 4IR is unleashing on humanity, it is imperative that humanity, more than ever before, fine-tunes its moral compass, for failing to do so leaves humankind at the whims of an elite of techno-savvy group of individuals. We ought to urgently clarify our moral values, and based on them, formulate clear guidelines to restrain developers and marketers of 4IR technologies from dehumanising the peoples of Africa by manipulatively imposing technological innovations on them. It is only through such an ethical framework that we can protect the individual's rights to personal choice and to privacy, as well as his or her physiological and psychological integrity. Yet in the African context, the rights just listed must be construed within a communalist framework that is antithetical to the individualist values of Western liberalism that manifest as capitalism in the economic sphere and as liberal democracy in the political. For example, capitalist theory and practice presume that intellectual property can only be owned by individuals, and yet African peoples often hold such property communally. Thus, while the West has propagated the framework of exclusive

individual intellectual property rights, it is difficult to see how a single individual could ever have moulded himself or herself from infancy to the level where he or she is able to arrive at innovations without the input of his or her society, and thereby to warrant his or her exclusive rights to such innovations. Even in highly individualistic Western societies, copyrights and patents are usually not granted in perpetuity. As Oruka (1997, 150) observes, "There is no country in which, …, one would accept a wish or a will from one of its citizens, which stipulates that upon death all his achievements, however dear to the country, should be exterminated or kept from use by anybody. …. The objection to this will can be supported by invoking issues of common origin, common security and commonwealth of the community of which the person was a member." All these considerations suggest that with regard to 4IR products and other innovations, African societies can opt for communal intellectual property rights.

We in Africa ought to deeply reflect on social visions such as that of Pixley ka Isaka Seme, which he articulated in his celebrated 1906 speech at Columbia University, where he spoke of a regenerated African civilization whose most essential departure "is that it shall be thoroughly spiritual and humanistic -indeed a regeneration moral and eternal" (SEME 1906, N.P). As Lamola (2021b) explains, for Seme, "the surrender of human agency to machines is … not fathomed. His was a novel conception of the possibility of the symbiosis of scientific progress with human spirituality." However, Seme's speech did not spell out what this moral and spiritual character would entail. Nevertheless, his vision can be augmented by the considerably large body of literature on the communalist orientation of African peoples (e.g. NYERERE 1974; MENKITI 1984; MASOLO 2009; WIREDU & GYEKYE 2010; OGUDE and DYER 2019). Our earlier reflections on the importance of ensuring that the 4IR technologies that we adopt meet the needs of all human beings, where we pointed out, among other things, the importance of guarding against technologies that diminish the quantity and quality of interactions in social contexts such as those among family members, colleagues and friends, is also relevant in this regard.

The need for an ethical orientation touches on all the previous three considerations because only through a firm grounding in moral values can we steadfastly pursue inclusiveness to meet the needs of all human beings, affordability to bridge the digital divide, and respect for the right to cultural identity to guard against cultural imperialism.

Conclusion

I began my reflections by cautioning against an outlook that views African societies, or any other societies for that matter, as collectivities of passive beings to be acted upon by technological advancements. Tanguay (2021) notes that a growing "tech for good" movement is actively exploring how to use technology to benefit society and build a more sustainable and equitable world By addressing social and economic challenges through, in many cases, integrating concepts of inclusion and diversity into solutions. The gist of my reflections is that as the peoples of Africa enter the Fourth Industrial Revolution, they ought to do so in a manner that upholds their human dignity, their liberty as communities and individuals, and, as a result, their human agency. This will entail a conscious and consistent repudiation of Eurocentrism in the realm of technology in line with Frantz Fanon's admonition:

> If we want to turn Africa into a new Europe …, then let us leave the destiny of our countries to Europeans. They will know how to do it better than the most gifted among us.
>
> But if we want humanity to advance a step further, if we want to bring it up to a different level than that which Europe has shown it, then we must invent and we must make discoveries. (FANON 1967, 315)

Relevant Literature

1. DESMOND, Ned., & LEE, Kai-Fu. "Ned Desmond Interviews Kai-Fu Lee at the Sight Tech Global Virtual conference," [organised by the Vista Center for The Blind and Visually Impaired], 2-3 December, 2021. Web**.**
2. DONOVAN, Paul. [Profit and Prejudice: The Luddites of the Fourth Industrial Revolution], 2021. Routledge: New York. E-book.
3. FANON, Frantz. [The Wretched of the Earth], 1967. Farrington, Constance trans. Penguin Books Ltd.: Middlesex. E-book.
4. FLOYD, Rob. "ACET Uses Artificial Intelligence to Predict Future African Infrastructure Needs," [African Center for Economic Transformation (ACET)]. 3 March, 2021. Web.
5. GYEKYE, Kwame. [Philosophy, Culture and Vision: African Perspectives], 2013. Sub-Saharan Publishers: Accra. Paperback.
6. GLEASON, Nancy. W. Ed. [Higher Education in the Era of the Fourth Industrial Revolution], 2018. Springer Nature Singapore Pte Ltd.: Singapore. E-book.

7. HAWKING, Stephen. W. “Foreword,” [World Report on Disability], 2011. Retrieved November 2021. Web**.**
8. JOHNSON, Nicholas., & MARKEY-TOWLER, Brendan. [Economics of the Fourth Industrial Revolution: Internet, Artificial Intelligence and Blockchain], 2021. Routledge: New York. E-book.
9. LA BOÉTIE, Étienne de. [The Politics of Obedience: The Discourse of Voluntary Servitude], 2002. Kurz, Harry Trans. The Mises Institute: Auburn. E-book.
10. LAMOLA, M. John. “Africa in the Fourth Industrial Revolution: A Status Question is, from the Cultural to the Phenomenological,” [African Values, Ethics, and Technology, Beatrice OKYERE-MANU Ed.], pp35-52, 2021a. Palgrave Macmillan: Cham. Paperback.
11. LAMOLA, M. John. “The Future of Artificial Intelligence, Posthumanism and the Inflection of Pixley Isaka Seme’s African Humanism,” [AI & Society], 2021b. Web**.**
12. LAZAR, Jonathan., & STEIN, Michael. A. “Introduction,” [Disability, Human Rights, and Information Technology, Jonathan LAZAR & Michael Ashley Stein Eds.], pp1-8, 2017. University of Pennsylvania Press: Philadelphia. E-book.
13. LEE, Kai-Fu. [AI Superpowers: China, Silicon Valley, and The New World Order], 2018. Mariner Books: New York. Paperback.
14. Mangena, Fainos. “Ethno-philosophy is Rational: A Reply to Two Famous Critics,” [Thought and Practice: A Journal of the Philosophical Association of Kenya], pp. 23-38, 2014. Vol 6 No2.
15. Masolo, D.A. 2009. “Narrative and Experience of Community as Philosophy of Culture: Community as Method and Principle of Thought,” [Thought and Practice: A Journal of the Philosophical Association of Kenya], pp43-68. Vol 1 No1. Web**.**
16. MBITI, John. S. [African Religions and Philosophy], 1969. Heinemann: London. Paperback.
17. Menkiti, Ifeanyi. 1984. “Person and Community in African Traditional Thought,” [African Philosophy: An Introduction, Richard WRIGHT Ed.] University Press of America: Lanham, MD. Paperback.
18. NYERERE, Julius. K. [Ujamaa: Essays on Socialism], 1974. Oxford University Press: Oxford. Paperback.
19. ODUOR, Reginald. M.. “Western Liberalism, African Communalism, and the Quest for an Adequate Ideological Foundation for the Recognition and Protection of the Rights of Persons with Disabilities in Kenya,” [East African Law Journal], pp29-49, 2016/2017. Web**.**

20. ODUOR, Reginald. M.. "Nationhood and Statehood: The Impact of a Conflated Discourse on African Polities and their Non-Dominant Ethnic Groups," [Utafiti: Journal of Humanities and Social Sciences], pp45-66, December, 2018. Vol 13 No2. Web**.**
21. OGUDE, James., & DYER, Unifier, Eds. [Ubuntu and the Everyday in Africa], 2019. Africa World Press: Trenton. Paperback.
22. OKONDO, Peter. J.H. "Prospects of Federalism in East Africa," [Federalism and the New Nations of Africa, David P. CURRIE, Ed.], pp29-38, 1964. The University of Chicago Press: Chicago.
23. ORUKA, H. Odera. [Practical Philosophy: In Search of an Ethical Minimum], 1997. East African Educational Publishers: Nairobi. Paperback.
24. ORWELL, George. [1984], 1961 (1949). Signet Classic: N.P. E-book.
25. RASHIED , Naiefa., & BHAMJEE, Muaaz . "Does the Global South Need to Decolonise the Fourth Industrial Revolution?," [The Disruptive Fourth Industrial Revolution: Technology, Society and Beyond, Wesley DOORSAMY, Babu Sena PAUL & Tshilidzi MARWALA, Eds.], pp95-110, 2020. Springer Nature Switzerland AG: N.P.
26. SANTAMARÍA, Gerardo del Cerro. "A Critique of Neoliberalism in Higher Education," [Oxford Research Encyclopedia of Education], 2019. Web**.**
27. SCHWAB, Klaus. "The Fourth Industrial Revolution: What it Means, How to Respond," [World Economic Forum], 14 January, 2016. Retrieved November 2021. Web**.**
28. SEME, Pixley Ka Isaka. "The Regeneration of Africa," April, 1906. Retrieved 14 August, 2021. Web**.**
29. Sight Tech global. "Our AI Future is Already Here," December, 2020. https://www.youtube.com/watch?v=9fgfdUifkls Retrieved November 2021. Web**.**
30. TANGUAY, Geneviève. "Addressing the Ethical and Social Challenges of Emerging Technologies: Creating the Conditions to Play a Leadership Role in the Fourth Industrial Revolution," [The Fourth Industrial Revolution and Its Impact on Ethics: Solving the Challenges of the Agenda 2030, Katharina MILLER & Karen WENDT, Eds.], pp1-14, 2021. Springer Nature Switzerland AG: N.P. E-book.
31. TAYLOR, Charles. "The Politics of Recognition," [Multiculturalism: Examining the Politics of Recognition, Amy GUTMANN, Ed.], pp25-73, 1994. Princeton University Press: Princeton, NJ.

32. UNITED NATIONS ORGANISATION. “International Covenant on Civil and Political Rights.” 1966. Web.
33. UNITED NATIONS ORGANISATION. “Convention on the Rights of Persons with Disabilities,” 2006. Web.
34. WIREDU, Kwasi., & Kwame GYEKYE. Eds. [Person and Community: Ghanaian Philosophical Studies, I], 2010. Council for Research in Values and Philosophy: Washington, D.C. E-book.
35. WORLD HEALTH ORGANISATION. [World Report on Disability], 2011. Web.

Indiscipline as Method: From Telescopes to Ventilators in Times of Covid

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Abstract
There is no unproblematic way to study things as "African", yet an epistemologically situated approach based on concrete technological projects situated in Africa and their social and political implications offers an important account of the intersection of the Fourth Industrial Revolution and African Studies. We explore this perspective through the notion of "indiscipline" using the Square Kilometre Array radio telescope project (SKA) based in South Africa as a case study through which to observe "indiscipline" as a methodological approach to technoscience at work. Indiscipline helps frame the socio-technical (by)products of astrophysics and engineering, and we present the production of ventilators for COVID-19 patients as an example of how the design of mega-science projects can become entangled with the dynamic concerns of society. Our conclusion elaborates on the politics of large technological systems, opening up a conversation on the intersection of science and society in the context of the Fourth Industrial Revolution in African settings, using the template of experiences with the SKA and the National Ventilator Project in South Africa.
Keywords: Transdisciplinarity, Interdisciplinarity, African Studies, SKA, 4IR, National Ventilator Project

Introduction

There is no unproblematic way to study things as "African" or in "an African way", least of all in terms of doing scholarship amid the epistemic and scientific crisis happening alongside the Fourth Industrial Revolution (4IR). Attempting to characterize Africa as a whole results in a hopeless reduction of the continent's multiple realities, histories, and ontologies into one neat narrative.[1] Taking a situated approach from postcolonial Science and Technology Studies (STS), and the notion of "co-production" (JASANOFF 2004) in particular, we frame technology and society as always located in a geographic place and in an epistemic frame; its industry-related variant has come to be called "inclusive innovation" in development discourse. The technological system we focus on is the Square Kilometre Array (SKA), a large-scale international radio telescope project which exemplifies methodological perspectives and analytical tools for framing technological advancement in Africa. In further developing co-production or inclusive innovation as useful notions, we add the idea of "indiscipline" as a method to observe and account for the context in which trans- and inter-disciplinary research unfolds. Indiscipline is seen as a decolonial update of transdisciplinary thinking, focusing on moments of rupture and puzzlement when leaving familiar epistemic terrain.

Conceived of as a deliberate method, indiscipline is a tool for making research objects visible. In our case, this entails the realization that digital technology is culturally situated in a Euro-American imposed hegemony, and, thus, socially charged by historic power relations. In addition, these technologies structure social behaviour and the lifeworlds of people outside these hegemonic set-ups in different ways. Indiscipline is employed as an analytical category that implies a deliberate methodological messiness (MITCHELL 1995), which has productive potential for researching the political, material, and epistemological entanglements at the intersection of 4IR and African Studies.

Our approach for eliciting the method of indiscipline is narrative eclecticism or "analytics as story" (MCKITTRICK 2020, 12) whereby 'story' is deployed as a tool and a unit of analysis. Storytelling is a common mode of co-production and indisciplined collaboration, which, on the one hand, tells us something about the "materiality of our analytical worlds" in demarcating the terrain and accounting for lived experience in the physical world, and on the other hand, allowing for explorative ways of enquiry (MCKITTRICK 2020, 12); stories create space for conceptual deviations from normative accounts of how research is conducted.

[1] LAMOLA, John. 2021. African Studies and 4IR: In Search of an Appropriate Analytical Approach. Roundtable hosted by the University of Johannesburg

The Square Kilometer Array radio astronomy project and its involvement in the 'down to earth' concerns of providing technological solutions to a medical problem by producing autonomous ventilators is the empirical anchor we use to zoom in on the material products, and technological spin-offs transgressing the boundaries between basic and applied technoscience. Our story-telling of indiscipline in terms of the National Ventilator Project, which is a specific offshoot of the SKA in a time of crisis, elicits how this mega-science project has become 'grounded', situated, and effective (in the sense of co-production) in a political context, national interests and regional power structures. In speculating on the applicability of indiscipline to analyze the offshoots of large-scale science projects in Africa, we think about the politics of these technological systems in the Global South within wider debates on, for example, the need for more democratic, inclusive and relevant technical innovations in general and during the Coronavirus pandemic in particular (PARTHASARATHY 2017; 2020).

Our article is structured in four parts. We first define the concept of indiscipline, its provenance in the domain of interdisciplinarity and its promise for a decolonial application in Science and Technology Studies. The theoretical backdrop for relating indiscipline to STS will be explicated in a second step by drawing on Sheila Jasanoff's (2004) notion of co-production which locates knowledge production within the 4IR between the material, political and historical. Third is our core argument which is based on outlining William John Thomas Mitchell's (1995) five-step framework of indiscipline as a method for research, which we update alongside a discussion at the intersection of decolonial 4IR and the social sciences using two examples: first, a talk by Amanda Weltman about the methodologies behind radio astronomy and, second, the National Ventilators Project in South Africa, an unlikely offshoot of radio telescope engineering skills triggered by the Coronavirus pandemic. Based on these stories, we speculate on how indiscipline as an analytical framework and methodological procedure can breathe life into intersectional research in decolonial settings.

Defining indiscipline

Doing scholarship at the intersection of 4IR and African Studies, in particular, is like walking at the edge of the abyss where the ground upon which one stands is shaky (MACAMO 2018, 5). It involves exploring unlikely connections and disruptions by asking, *What Do Science, Technology, and Innovation Mean from Africa?* (MAVHUNGA 2017).

An interdisciplinary approach, we feel, is not sufficient for exploring and realizing science and technology in decolonial settings. Typically, interdisciplinary work involves comparison or the application of tried and tested methods to known problems that guarantee results, giving the impression that a scholar ought to be versed in more than one discipline (MITCHELL 1995, 540). In his proposition of indiscipline as an alternative, W.J.T. Mitchell (1995) targets visual culture, but we find the logic of his argument particularly compelling and productive for Science and Technology Studies in a decolonial setting. Indiscipline is an attempt to outgrow interdisciplinarity and to make scholarly work more "adventurous" and political, rather than simply "look professionally respectable and safe" (MITCHELL 1995, 540). We contend that an *indisciplined* approach reveals the inadequacies of theoretical and conceptual tools, not just in social science but in African Studies more specifically. To quote Mitchell:

> My real interest [is] in forms of 'indiscipline', of turbulence or incoherence at the inner and outer boundaries of disciplines. If a discipline is a way of ensuring the continuity of a set of collective practices (technical, social, professional, etc.), 'indiscipline' is a moment of breakage or rupture, when the continuity is broken and the practice comes into question. To be sure, this moment of rupture can itself become routinized… Nevertheless, there is that moment before the routine or ritual is reasserted, the moment of chaos or wonder when a discipline, a way of doing things, compulsively performs a revelation of its own inadequacy." (MITCHELL 1995, 541)

We expand on Mitchell, framing indiscipline as a method for opening up and reforming disciplinary routines that contributes to transdisciplinary research. While *Inter-* implies a reluctant lingering within the endogenous boundaries, *trans-* suggests a more forceful and sustained crossing of epistemes (MIGNOLO 2011b). Transdisciplinarity is therefore essentially an "act of liberating disciplinary boundaries" (TAKEUCHI ET AL. 2020, 6). *Trans-*gression is not only a "going between" structures and modalities, but also "going beyond" conventions (HUA & WEI 2020, 236). Indiscipline is then a subcategory of transdisciplinarity that focuses exactly on the moment of ruptured puzzlement.

Indiscipline as a way of enacting transdisciplinarity can be captured through storytelling. Disciplinary crossings enable the "deployment of fresh action, notably through narration" (GODART & WHITE 2010, 568). Storytelling is a central tool of indiscipline that enables mutual understanding and moments of innovation by recontextualizing the known and seeing them in a new light. Indiscipline, therefore, emerges through crossing the boundaries of standardised epistemic enquiry and opening up alternative ways of seeing and experiencing. While this formulation points to concerted efforts at disruption, one can, with a critical lens, observe ongoing acts of interdisciplinary collaboration as they already exist in the everyday lives of people. The work of description is absolutely critical in capturing these moments of disruption and disseminating them. Such has been the project of post-colonial scholars with a strong foundation in the humanities, philosophy and social sciences. Critical thinking about power and inequality[2] is underrepresented in the technical and natural sciences in Africa (BRAHIMA ET AL. 2020). To start to fill this gap, we offer an indisciplined perspective on events that are already in and of themselves, indisciplined.

Indiscipline and co-production

The efforts of the African 4IR notwithstanding, and not to belittle the burgeoning interest in digital activities in and/or from Africa, techno-science in Africa, by and large, proceeds along networks of dependency and inequality that have been in place since the colonial period. Additionally, today, Google and Facebook are present in Africa's new tech hubs, where technology, innovation and capitalist entrepreneurism exist as islands that contrast starkly with the underdevelopment of surrounding neighbourhoods.[3] Interventions by social scientists that question the direction of development and technology in Africa will go largely unnoticed due to differences of power and inequalities in funding, as well as the value of knowledge produced between the soft and the hard sciences. That said, there is reason for some encouragement for staying with the "trouble", as Donna Haraway (2016) says. Remaking the "troubled" world is to find approaches that disrupt nature/culture binaries as well as other dualisms obstructing human creativity, and potential relations, or entanglements with other-than-human kin (including the environment). While Haraway's aspirational stance envisions an ever more entangled future with the non-human, Sheila Jasanoff's notion of "co-production" sees technology,

[2] For pioneer work in this area see for instance Thomas-Emeagwali & Shiza (2016); Webb (2013); Leeuw (2014).

[3] See for example, Africa's new IT hubs including "Yabacon Valley" in Lagos, or Konza Technopolis in Kenya, or Ghana's Google AI centre, all of which are in part sponsored by Google or Facebook, as well as sites for African start-ups.

at least, as always, already imbricated in, and co-produced with societies. In both cases, these authors articulate a model of co-production and, thus, are opposed to positivism, which, as seen in development efforts, orients towards technoscience in its determinist sense. In Jasanoff's words:

> We gain explanatory power by thinking of natural and social orders as being produced together […] Briefly stated, co-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it […]. Scientific knowledge, in particular, is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments and institutions – in short, in all the building blocks of what we term the social. The same can be said even more forcefully of technology. (JASANOFF 2004, 2-3)

This perspective comes from post-colonial approaches in STS that foreground technology's inherently political dimension (HARDING 2011; JASANOFF 2004) as being a product of a place, a time, and a set of interests. Technology does not exist above or outside of society, in difference to the tech hubs on digital islands such as Silicon Valley-derived sites, but is already fully immersed in society, inscribing, shaping and being shaped through human activities. To take a perhaps oversimplified example for the sake of illustration, consider this interaction that took place between one of the co-authors and an astrophysicist:

> A colleague of ours is an astrophysicist. After a long evening of working on his computer inside the Ghana Radio Astronomy Observatory, I [James] ask him to take me outside and show me what he is looking at. We walk out and the first thing is confusion: "Well, we cannot actually see it". He then asks me to find Orion and from there we can triangulate the position of the exploding star he was looking at earlier inside the observatory. We find it and he says: "There". It is invisible, we cannot see it, but it is there.

If the location of Orion in the sky is situated in that space in Ghana, and in that particular time in 2018, then it is, in essence, a co-production of the astrophysicist's training in science, and the social, physical and historical context of that knowledge of triangulating location. How it is seen becomes the problematic crux of the matter which involves applying a set of theoretical frameworks, conceptual categories and methodological procedures through

which the object of research is contrived (MACAMO 2018). In some sense, we should be asking in the social sciences "Where is Orion?" and then using that to triangulate how we make objects of research visible, particularly when those objects sit at intersections, for instance, of technology and society, 4IR and African Studies. What happens, therefore, when we look to astronomy with the interest in STS and - in particular - the Fourth Industrial Revolution? What sorts of topics emerge out of this constellation of disciplines? These questions can be addressed through a situated story, one that makes visible co-production at a particular time and place to better understand the co-production between a radio astronomy mega-science project and the demands placed on society by Coronavirus. Where is our Orion in this narrative? This is the question that takes us to through the next analytical steps.

As we have been arguing, indiscipline, as one way to nudge, encourage, or swing the lens onto moments of co-production at the interaction of technoscience and society through which we can tell stories about the mixing of material and social politics:

> When we tune into the rhythms of everyday life even at times of rapid technoscientific change [as in 4IR], we experience more often the steady hum of continuity than the sense of disequilibrium. In short, the ways in which we take note of new phenomena in the world are tied at all points – like the muscles on a skeleton or the springs on a cot frame – to the ways in which we have already chose to live in it. (JASANOFF 2004, 16)

By inserting co-production into a theory of the 4IR in Africa, we avoid the problem of characterising something in terms of either social determinism or digital determinism – it is symmetrical and. Thus, a critique of the realist ideology that "separates the domains of nature, facts, objectivity, reason and policy from those of culture, values, subjectivity, emotion and politics" (JASANOFF 2014, 3). The research object is not technology *for* Africa, so much as the co-production of Africa *and* technologies, the representational modes and material outputs that index Africa, which are embedded in technology.

The political question is about how to capture the moments of crystallisation that speak for the interests of Africans, a question that will inevitably lead to different perspectives and conflicts, which can be struggled over in a democratic fashion. A practice-based study will train our attention to contested moments and normative stabilisation, which tell us what the stakes are and who stands to gain or lose. Therefore, what cultural or economic or political values are attached to this knowledge?

Applying indiscipline as a method

From co-production to collaboration

While an STS approach to collaboration emphasizes the agency of the material, i.e., "how the natural and the social are produced together" (JASANOFF 2014, 3), a conventional understanding of interdisciplinarity emphasizes the cognitive opening of humans to alternative ways of thinking. In both instances, the certainties of the self are unsettled by demanding a counter-intuitive, deliberate abandonment of epistemological and ontological stability. Both argue that instead of leading to fatalistic exasperation, doing collaborative post-colonial sciences and recognizing the implicit co-productive dimension respectively, is a necessary and fruitful next step in innovative research that tackles the problems of the 21st century (HARDING 2011, 22). Cosmologist Amanda Weltman provides an example of this kind of co-productive transdisciplinarity during her presentation on 'Fast Radio Bursts' at the *South African Astronomical Organization Conference* (SAAO) in 2020. In the following, we unpack her presentation through the lens of "indiscipline" and work up our level of analysis of the main case study, the National Ventilator Project.

Amanda Weltman at the South African Astronomical Organization Conference

In her SAAO presentation in October 2020, Amanda Weltman,[4] who holds the NRF South African research chair of Physical Cosmology at the University of Cape Town, presented her latest findings on Fast Radio Bursts, which were discovered, computed, and thus brought to life through SKA technology. Fast Radio Bursts are a sort of ultra-high regular energy signal that potentially hints at the collision of supernovas. The interdisciplinary set-up of the audience celebrating SAAO's 200-year anniversary and the many laypeople attending the conference inspired Weltman to also share some meta-reflection of the collaborative research process on Fast Radio Bursts. She stated that initially, Fast Radio Bursts were not found due to technical innovation but due to an "attitude shift to look for them" (WELTMAN 2020); i.e., by a different way of looking at reality and "finding Orion". Whether that shift was induced by an indisciplined encounter, as such, remains speculative. Weltman's accounts on Fast Radio Bursts, nevertheless, give some illustrative clues about the relevance of the five methodological steps suggested by Mitchell for indisciplined collaboration. We explore these in the following and signal how the framework helps to analyze the intersection of STS, 4IR and African Studies.

[4] Amanda Weltman is Professor for cosmology at the University of Cape Town and Director of the High Energy, Physics, cosmology and Astrophysics Group. She has been described as Africa's "next Einstein" (SIDDLE 2016).

1. ***Disciplinary self-reflexivity*** pertains to an honest exploration of the power relations, the historicity of both the research object and the researchers' roles in the research process at the intersection of social and natural sciences.
Weltman starts her presentation with a reflexive definition of her field of cosmology contrasting it to and complementing it with the mothership, astronomy:

> I think it's worth thinking about some of the history of what cosmology has meant in the past and to different societies at different times. So, the goal of cosmology is really building a system of understanding a way and have beliefs about the origin and structure of the universe…so space, the planets, celestial phenomena. Historically, this has been underlain by deep religious beliefs and ideologies and it's only really in modern times that cosmology has taken the step up from being a belief structure, a philosophy, a way of looking at the world. It's become something very scientific by building our ideas with astronomy as a way of measuring and mathematics, as a way of thinking through theories. And so, we try to answer the largest scale questions in the universe using very often very small-scale physics. …Advances in cosmology require advances in astronomy. And that's why I think it's so important to have these cosmology and astronomy discussions together. What do we need to do to build a theory of the universe and understand everything on the largest scales? (WELTMAN 2020, N.P)

In providing a historical trajectory of her field, Weltman also implicitly alludes to the legitimation struggles of cosmology against and with astronomy. Weltman emphasized the need for collaboration in order to see the bigger picture and answer "large scale" questions.

An analysis of the social and historical situatedness of the production and reception of technological knowledge is a crucial part of innovation. Social sciences in this endeavour can help make these positionalities and power relations transparent by decentring positivist Eurocentric axioms and claims to universality. Politicizing the research in such a way might not always be welcome. Therefore, the intervention of social science should find a role that goes beyond the deconstructive armchair critique (or the moralizing compliance police) and towards an explicitly productive contribution, e.g., in highlighting the role of documenting the research through (self-)critical, complex, and contextualized narratives. While these roles can certainly be overlapping, partly obscure, and dynamic, it is important to be aware of these facets and respective power implications. Through "adamant self-reflexivity" (WIJNGAARDEN & IDAHOSA 2020) indiscipline foregrounds a proactive, productive, responsible and transparent engagement in the process.

2. Resistance to indifference through multiplicity. Traditionally, it is the post-colonial social researcher's main agenda to point out the context-specific constructedness and multiplicity of sciences and technologies. In line with taking on a responsible role in technological innovation, indisciplined co-production should, however, not be satisfied with stopping at, and being defeated by, these boundless pluriverses. What McKittrick (2020) claims for 'Black method' is equally applicable to indiscipline; viz. an assertion of our own normative underpinnings and a resistance against getting lost in, or being dragged down by, absolute relativity. Indiscipline is "not continuously and absolutely undisciplined (invariably without precision, invariably undone)" but instead strives to be "precise, detailed, coded, long, and forever" (MCKITTRICK 2020, 5f). Earnest indisciplined collaboration should – at least, within the horizon of the team – seek binding epistemological common ground axioms and norms (see ODOUR[5] this issue) from where to work. In Harding's words, these anti-relativistic "standpoints" are more than perspectives or views but "intellectual and political achievements in that a group has to work together to figure out how to arrive at them" (HARDING 2011, 19f).

Weltman affirms both the normative in stressing the data-driven ontology and logic-based methods, as well as the conceptual openness in highlighting the need to critically interrogate existing data-based certainties and conceptual correlations:

> When we have limited resources and limited data, we introduce bias into what we follow up. So, there's one very well understood FRB [Fast Radio Burst] and we keep studying it and if we delude ourselves into thinking it's typical, then we will miss out on a lot of new information. Just because we've convinced ourselves that magnetos are very likely progenitors, it doesn't rule out other mechanisms. … And so, we have to rule things out; either the data must rule it out or there must be a theoretical explanation for why it cannot happen.

Weltman's account can be read as the co-productive emergence of knowledge, i.e., a give and take between the materiality of data and an alternated social dimension, a change in attitude and viewpoint if you will:

[5] Odour proposes Universal Design, Affordability, Cultural Identity, and Ethical Orientation as guiding norms for the Fourth Industrial Revolution in Africa (2021).

> There's a huge amount that we can learn from Fast Radio Bursts; not just scientifically but also how we do science. So, the fact that they were found originally with no technological innovation, just the fact that we thought to look in a different way at the existing data, is something that I think is really worth taking away. …. Yes, we need new tech advances now to see new results, but we should never forget the existing data may have a lot of science hidden up in it.

Crossing disciplinary boundaries involves a risky give and take, i.e., the readiness to genuinely invest in "foreign" ways of knowing and, in the process, being prepared to lose hard-earned certainties.

3. Co-producing instead of recycling concepts. Striving for a new language instead of simply importing or 'recycling' worn-out concepts that are safely used in the home disciplinary discourse is crucial in achieving common ground (MITCHELL 1995, 52). Central to creating mutual understanding as well as conceptual, affective learning is the creation of new polyvalent metaphors that enable the expansion of known attributes with new aspects; in other words, we can only understand new connections based on already familiar units. The collaborative construction of new metaphors goes beyond a creative communicative exercise but also opens ways of grasping and talking about previously unknown phenomena based on existing shared knowledge bytes. Metaphors are both an "(entwined material and imagined) future that has not arrived and the future we live and have already lived through" (MCKITTRICK 2020, 11). They describe scenarios of what might be with items we already know by assembling them anew. Through their semantic openness and ambiguity, metaphors "concretely" and simultaneously represent the problem and the solution. Through their aesthetic iconic dimension, they have the power to affectively "move" (MCKITTRICK 2020, 11) cognition. Metaphors, thus, not only describe a reality but also create and embody this reality, e.g., when classifying a specific radio signal as a "burst", this becomes a research object and sub-discipline of cosmology.

The negotiation about meaning can be achieved through dialogue and dialectics. The process of achieving mutual intelligibility involves the 'dumbing down' of acquired knowledges and might feel like a loss of complexity and advancement. But if it is for achieving commonality, in the literal sense of making knowledge accessible by employing less specialized language, it can go a long way in opening windows for collaborative innovation.

At the SAAO conference, Weltman had mastered this "dumbing down" exercise by adjusting her complex research results to a heterogeneous audience while fully retaining both her expert authority and respectful eye-level status towards the listeners. The materiality of the situation, i.e., a commemorative large scale public interest online conference, required utmost simplicity and brevity but also a measure of entertainment and awe. Instead of explaining the cumbersome theoretical axioms such as the Standard Model for Theory of Matter and Non-Gravitational Interactions, Weltman opted to show a photograph of her son wearing an imprint of the related formula on a T-Shirt. In doing so, she signalled that it is not so important to understand the formula itself but rather to understand its significance for the field, such that it warrants an iconic, star-like, branding on a T-Shirt. While often the 'dumbing down' only provides a unidirectional benefit, Weltman herself implied the possibility that a fresh look on data induced by interdisciplinarity might lead to genuine insights.

4. Analysis of the metaphysics of the object. The conceptualization and framing of the unknown — in particular the future of humanity — is an important part of 4IR that requires us to consider the "metaphysical consequences of the technological reconfiguration" (PIRC this issue). Furthermore, in focusing on co-production as the starting point for indiscipline, the method can "respond to people's deepest metaphysical concerns" (JASANOFF 2004, 21) by addressing the question of what we perceive as material and cognitive reality and how they relate to each other; i.e., how the human is connected to the world. In establishing this relationship, the nature and trajectory of humanity crystallizes. Weltman describes cosmology as "a framework that includes humanity", i.e., a discipline that also examines the relationship between the cosmos and humans.

An interesting example of that intersection is the work of Franco Vazza and Alberto Feletti (2020) who explore the neurological dimension of what can be grasped by humans. They quantitatively and structurally investigate the comparability of the human brain and the galaxy and find that "the self-organization of both complex systems is likely being shaped by similar principles of network dynamics" (VAZZA & FELETTI 2020). This suggests that how we perceive the cosmos is limited by the formatting of our brain's hard-drive, giving an indication of what is knowable in the first place, which is ultimately a metaphysical question.

Weltman addresses the anticipated metaphysical implications that cosmology triggers in the conference audience by admitting to being at the fringes of her discipline's knowledge: "Sometimes our cosmology is still built on beliefs and to really make progress we may have to question some of our beliefs and put them on firmer footing with evidence". Her statement highlights the overlapping of belief-structures with theoretical constructs requiring evidence to legitimize their existence. Theory can thus be understood as the material representation of metaphysic ontologies.[6] This illustrates that theory can be seen as "a form of storytelling" highlighting its "fictive", temporal and "speculative" aspects:

> Fact-finding, experimentation, analysis, study, are recognized as narrative, plot, tale, and incomplete inventions, rather than impartial treatises. As story, theory is cast as fictive knowledge …the act of teaching and telling the story is collaborative (I will share this with you, co-author this with you, and live this life with you, I will tell you my secret); the contents of the story are multifarious and interdisciplinary (characters, plots, twists, metaphors, unexplained codes, places, secrets, connotations, structure the lesson and telling). The lesson, the telling, the contents, are ways of life (ways of being) (MCKITTRICK 2020, 7f).

Thus, by focusing on the metaphysical groundings of research and the "fictional" nature of theory, indiscipline has the capacity to lay open conceptualisations of the unknown, the understandings of nature, origins and destiny of humanity and its relation to the cosmos, as well as the driving teleologies[7], ideologies, and agendas of science and technology.

[6] Weltman anchors the metaphysical underpinnings of her work in four theoretical pillars: Einstein's Theory of General Relativity, the Theory of Matter and Non-Gravitational Interactions (Standard Model); as well as two categories for "choices that we make based on data", i.e., geometry and topology. That is − almost literally – science understanding of the cosmos in a nutshell: "Putting together these very simple theoretical ideas, we arrive at the sort of surprising result that the universe began in a hot dance state that we now observe as the CMB [Cosmic Microwave Background]" (WELTMAN 2020).

[7] These worldviews are based on axioms of evolution, progress, and development of humanity ultimately believing that growth of knowledge automatically leads to betterment of society.

5. Analysis of the political economy of the object. In acknowledging that every knowledge is situated, what can become knowledge is subject to the institutional norms and standards within which scientific knowledge is produced. The importance of this aspect becomes evident, when considering how Weltman routinely acknowledged the political/institutional enablers of her work by lauding the "international collaboration", and thanking her research funders, the National Research Foundation of South Africa, as well as the organizers of the conference SAAO. Beyond mere politeness, this acknowledgement is an assertion and transparent revelation of the political and economic set-up of the research. It tells something about the contextual expectations of how she can tell and produce her story.

McKittrick points out how a narrative analysis of the political economy dimension is especially relevant at the intersection of 4IR and African Studies:

> Stories think through how racism and other forms of oppression underpin the political economy of academic and non-academic disciplinary thinking (the demand to gather and live with seemingly transparent data, in a range of sectors; living with data [policies, reports, cards and carding] that ostensibly prove that those communities living outside normalcy are verifiably outside normalcy (MCKITTRICK 2020, 3).

A strategic analysis of the political and economic situatedness of research, as suggested by Mitchell (1995), affords a change of parameters that yield more desirable results: South-South collaborations in technical knowledge production (RASHIED & BHAMJEE 2020), corporate and political interests in research results (BIRHANE 2020), and origin and trajectory of knowledge and theory (HOUNTONDJI 1990), as well as technology suitable for African contexts.

For the latter, we propose the South African Ventilator Project as a site of applying and testing indiscipline within the parameters of a particular context or example. The project arose during a global crisis, i.e., was urgent and need-driven; it received a national mandate and funding as well as the explicit involvement of humanities in logistics, consulting and communicating; it was set in an African context geared towards finding Africanized solutions and was dependent on, and influenced by, the existing infrastructure and materials, i.e., a necessarily co-productive project.

Application: Crystalizing the 4IR through the National Ventilator Project in South Africa

In her presentation, Weltman suggested that in scientific practice - whether it be radio astronomy or sociology - new information comes through rupture, i.e., a disturbance of old certainties. Her account is based on looking at existing data in a new way that requires an "attitude shift to look for them [Fast Radio Bursts]" (WELTMAN 2020). It is, thus, actually epistemological uncertainty (not certainty) that advances a discipline and interdisciplinary networks, suggesting that interdisciplinary projects are most productive when they embrace uncertainty and epistemological rupture (rather than retreating to common assumptions and behaviours). In order to explore these points further - and to link this to issues around innovation, astronomy, society, and 4IR - we turn to the technological "spin-offs" emerging out of the SKA radio astronomy project in South Africa.

Spin-Offs from the SKA

South Africa hosts the world's largest radio telescope, the Square Kilometre Array (SKA), and the biggest science project in Africa with the potential for many technological spin-offs (DAVIDSON 2012), which have scope for application in the Fourth Industrial Revolution. These are mainly in the domain of big-data processing, but also societal demands that elicit the innovative potential of radio astronomy engineers and managers.

As Davidson (2012) has illustrated, large-technology based missions in other parts of the world have shown that technology spin-offs are serendipitous rather than planned, lending themselves to an indisciplined approach. For instance, the integrated circuit technology at the heart of modern electronic devices was driven by the US space and missile programs of the 1960s. The invention of the World Wide Web at CERN was initially designed for sharing the results of particle accelerator laboratories but eventually revolutionised commerce and communication in an entirely unplanned fashion. Advances in robotics are being made by NASA's Jet Propulsion Laboratory with dual-use applications for the exploration of other planets and for medical projects such as robot-assisted microsurgery. Research into nuclear physics in South Africa had contributed both to upholding white minority rule as well as to medical applications in the 1950s (BEINART & DUBOW 2021). In this frame, the SKA features in this larger history of innovation by driving - amongst other things - semiconductor chips for very large-scale computing.

The innovative potential of the SKA outside of radio astronomy has emerged from the challenges and innovations of the technological and engineering requirements of using an interferometric array of one million square meters[8] where data processing and timing has become a major challenge. While the present data rates can be handled with current technology, the SKA will require computation rates that exceed the capacity of existing computers. It is not clear, for example, whether an ExaFLOP — i.e., super computing speed — is technically feasible but research is underway that will spin-off into other fields where large data sets must be processed. The ROACH (Reconfigurable Open Architecture Computing Hardware), which was developed in South Africa in collaboration with international organisations and the University of Cape Town is at the center of this development in high-performance computing.[9]

The SKA is not just an engineering project. It also has a strong human capital development programme with hundreds of MA students, PhD students and post-doctoral fellows, as well as several national-level research chairs, made available. In addition, there are new initiatives in radio astronomy that are not directly linked to the SKA site in South Africa but have resulted in high-level activity such as the development of the African Very Long Baseline Interferometry (AVN) Network, which is based on recycling recently decommissioned telecommunications dishes across Africa. The first conversion was in Ghana in 2017, which has had a significant impact on the building of astrophysics and big data processing in West Africa.

These developments in space science provide a counterexample to what Paulin Hountondji (1990) had argued in terms of Africa's scientific dependence. While the training of African scientists has notoriously taken place at institutions in Europe and North America, the SKA/AVN offer an infrastructure for educating a new generation of astronomers and data scientists. Although the best-equipped laboratories, the top universities, the most powerful research centers, editorial teams and offices of the most prestigious scientific journals, as well as the most complete reference libraries and publishing houses and the major concentration of practicing scientists still remain outside of Africa, the SKA/AVN has the unique potential to be an infrastructure through which students on the African continent can do experiments and research on home ground.

[8] The basic method of interferometric radio astronomy is connecting dishes over vast distances to create one massive virtual dish whose collecting area amounts to the space in between them.

[9] Its applications outside of astronomy include radar systems such as ground penetrating radars used for the detection of buried pipes during construction work, and collision avoidance radars under investigation for motor vehicles. Therefore ROACH-board technology may well be one of the first candidates for a new spin-off development.

Having mentioned some of the industry grade spin-offs from the SKA, we turn now to a particularly interesting case, and the most recent example of a spin-off that is unfolding through the story of the National Ventilator Project (NVP).

South Africa, Astronomy & Ventilators

In 2020 when the number of coronavirus cases began to increase in South Africa, the government called on companies and experts, engineers and scientists to develop innovative solutions to help combat the pandemic. Anticipating the demand for critical medical supplies, the Department of Trade, Industry and Competition invited companies and experts to express their interest in the design, development, production and procurement of equipment such as ventilators. Experts and companies registered their interest and relevance to the National Ventilator Project (NVP), an example of partnership and innovation toward a common objective to help patients get oxygen by pumping air into their lungs with no need for electricity. This is contextually relevant since South Africa has an ongoing problem of stabilising its electric grid, an obvious hamper to economic growth not to mention the reliable operation of medical services.[10] Within the space of four months, South Africa had gone from not producing any ventilators at all to having the first units in production, and identified that there was the industrial capacity to scale-up production for exporting ventilators to other African countries.

[10] For instance, see 1. https://www.opml.co.uk/blog/south-africa-s-crippling-electricity-problem and 2. https://www.bloomberg.com/news/articles/2021-01-17/eskom-extends-south-africa-power-cuts-due-to-lack-of-capacity

The astronomical community has been active, offering their skills to help address the challenges of COVID-19. On 9 April 2020, the Minister of Trade and Industry, Ebrahim Patel, mandated the South African Radio Astronomy Observatory (SARAO) with overseeing the development and manufacturing of ventilators based on the experience they have gained in developing the complex systems for the MeerKAT radio telescope, a precursor to the SKA (SARAO 2020). SKA project director Bernie Fanaroff asserted that, "if we have the skills that put the MeerKAT together, why can't we use them to put together medical capacity?" (WILD 2020). SARAO members, according to Fanaroff, "are amongst the best system engineers and system integrators in the country and the lessons they learned designing complex systems in a very efficient way [for MeerKAT] has allowed SARAO engineers to work through a large number of options and designs in a very short time" (WILD 2020). A network of astronomers, scientists and engineers were tasked with conceptualising a local ventilator design, and engineers at the South African Radio Astronomy Observatory had produced two mechanical ventilator prototypes, which provide a mixture of oxygen and air at a constant pressure to the patient with a non-invasive ventilation mask (which also prevents patients from infecting hospital staff and other patients). The alternative prototypes developed by SKA engineers provided a non-invasive ventilator system that does not require electricity to pump air into patients' lungs and were able to treat the majority of hospitalised cases. As they were simpler and locally manufactured, the new machines were significantly cheaper than imported ventilators.

The design is particularly innovative in terms of helping the patient recover from the virus without needing invasive ventilation. The very small overpressure of air ensures that the lungs remain inflated, promoting the efficient transfer of oxygen to the blood. For the critically ill, the standard medical response is tracheal intubation — the insertion of a flexible plastic tube via the mouth into the airway to move air in and out of the lungs. Khulu Phasiwe, a spokesperson for the Radio Astronomy Observatory, said about 75% of patients requiring hospitalisation for Covid-19 treatment only need low-level oxygen therapy and require non-invasive ventilator therapy. The aim is to ensure that ventilation, which is a painful, invasive and technical procedure, is the last option because putting foreign objects into the body introduces the possibility for infections and complications such as 'ventilator-associated pneumonia'.

Analysis

The production of ventilators facilitated by an astronomical organizational network makes visible the link between materials, systems, and political conditions in the context of an Africanized 4IR. As previously mentioned, the scope of spin-offs, of which the ventilator project is a part, also includes big

data processing and high-performance computing, which opens up further examples of the need for a 'trading zone' (GALISON 1997) between engineers and scientists from a variety of disciplines. Indiscipline not only foregrounds the political power of technology but also the relevant criteria for clearing the way toward the creation of widely accountable and locally relevant "inclusive innovation". Inclusive innovation is a buzzword in international development and technology discourse that differs from the earlier focus on large infrastructure projects, tending to emphasize small low-tech devices, driven by local concerns and interests (see e.g., PARTHASARATHY 2017). Therefore, an important premise for indisciplined collaboration is a social context where research and innovation are need-driven and applied.

Mitchell calls the "bottom-up model" of interdisciplinarity that emerges from the "shop floor…in response to emergencies and opportunities" (MITCHELL 1995, 541). While much of the innovation during the COVID-19 pandemic has been driven by elite concerns, capitalist interests and exposed societies gaping inequalities (PARTHASARATHY 2020), it has also enabled pockets of inclusive innovation due to these now very visible differences. Contemporary research is changed because political and ecological parameters have changed. A useful point of departure in elaborating on this is 'cosmopolitics' (STENGERS 2010), a conservative form of radicalism that creates an awareness of the situations that mobilise scientists and technologists toward matters of mutual concern.

Slowing down politics is a way to turn attention to the situatedness of technological design. The National Ventilation Project shows how a team of scientists, managers and engineers who are normally concerned with receiving signals from stellar objects had mobilised to produce appropriate technologies on a massive scale. Even though these air pumps run without electricity, have a simple design and require little prior expertise, they still require expansive infrastructure to produce, transport, and distribute them widely (within and beyond South Africa's national borders). These ventilators will be on the move, transferred from sites of central production to remote areas where they are most needed. Being 'low tech', they have a flexibility to travel almost anywhere.

While we do not yet have data to justify claims about what happens when these ventilators arrive in particular places, we might be able to speculate that – like the Zimbabwe Bush Bump (DE LAET & MOL 2000) – the ventilators do not impose, they address a need, and are adaptable, flexible and responsive.

Conclusion

In the context of African Studies and 4IR, we proposed indiscipline as a method to foster the political dimension of Science and Technology Studies (HARDING 2011) and a pathway to the social and material co-production (JASANOFF 2004) of Africanised technology. The quest was driven by curiosity, "sustained by wonder (the desire to know)" and derived from a dissatisfaction with the kind of standardized questions "that result in descriptive-data-induced answers" (MCKITTRICK 2020, 3).

Indiscipline can narrow down the gap between the application of post-colonial theory in STS and post-colonial critics' lingering in the realm of literature (ANDERSON 2009, 390). It allows for a decolonial reading of STS, because it foregrounds disciplinary and cultural diversity, which advocates in Mignolo's sense for epistemological "disobedience" (MIGNOLO 2011a, 54). We believe that a foregrounding of technology's political implications is necessary for clearing the way towards the creation of widely accountable and relevant technological innovation (HARDING 2011).

In illustrating indiscipline as a method, we have drawn on several narrative examples that are grounded in South African astronomy: Orion, the Fast Radio Bursts and the 'unplugged' ventilators. Narratives, captured in various textual genres, can provide a new path for thinking about decolonial technology. Due to their eclectic incongruence, these texts can support the illustration of challenging "the primacy of evidentiary and insular normalcies" (MCKITTRICK 2020, 3):

> "In assembling ideas that are seemingly disconnected and uneven (the seabird and the epilogue, the song and the soil, the punch clock and the ecosystem …), the logic of knowing-to-prove is unsustainable because incongruity appears to be offering atypical thinking. Yet curiosity thrives. The industry punch clock calibrates and recalibrates the ecosystem." (MCKITTRICK 2020, 3)

Our examples of applied indiscipline at the intersection of African Studies and the 4IR have provided cues for thinking about interdisciplinarity in decolonial contexts. This invites further empirical analysis and story-telling around matters of mutual concern between the sciences and society, between the disciplines and amongst discrete groups of engineers, technologists, astrophysicists, managers and government officials whose engagement provoked moments of indiscipline, rupture and disruptive innovation.

While the gaze into outer-space is mediated from a position on (or near) earth, it is still emplaced within specific social, technological, economic and historical conditions. Relating the metaphysics and political economy of the object puts attention on the situatedness of research affording more desirable technologies that are suitable for particular contexts. Exploring indiscipline through narration and storytelling we account for the cosmopolitical intersections of exploding stars, supernovae, supercomputers, ventilators, people and viruses. This has opened up a methodology of indiscipline and moments of co-production, which yield innovation that is inclusive, representing a shift in focus - through narrative - to earth-bound concerns that are made visible during a pandemic crisis.

Relevant Literature

1. ANDERSON, Warwick. "From Subjugated Knowledge to Conjugated Subjects: Science and Globalisation, or Postcolonial Studies of Science," [Postcolonial Studies], pp389-400, 2009. Vol 12. No4. Paperback.
2. BEINART, William., & DUBOW, Saul. [The Scientific Imagination in South Africa: 1700 to Present], 2021. Cambridge University Press: Cambridge. Paperback.
3. BIRHANE, Abeba. "Algorithmic Colonization of Africa," [SCRIPTed], pp389-409, 2020, Vol. 17. Web.
4. BRAHIMA, Abraham., TURNER, Irina., & WOLDEGIORGIS, Emnet.T. "Epilogue: A Long Way towards a Decolonial Future in African Higher Education," [Decolonisation of Higher Education in Africa: Perspectives from Hybrid Knowledge Production, Emnet WOLDEGIORGIS, Irina TURNER, Abraham BRAHIMA Eds.], pp230-240, 2020. Routledge: London. Paperback.
5. DAVIDSON, David. B. "Potential Technological Spin-offs from MeerKAT and the South African Square Kilometre Array Bid," [South African Journal of Science], pp1-3, 2012. Vol 108 No 1/2. Paperback.
6. DE LAET, Marianne., & MOL, Annemarie. "The Zimbabwe Bush Pump: Mechanics of a Fluid Technology." [Social Studies of Science], pp225-63, 2000, Vol 30, No2. Paperback.
7. EMEAGWALI, G., & SHIZHA, E. (Eds.) [African Indigenous Knowledge and the Sciences: Journeys into the Past and Present], 2016. Sense Publishers: Rotterdam. Paperback.
8. GALISON, Peter. [Image and Logic: A Material Culture of Microphysics], 1997. Chicago University Press: Chicago. Paperback.
9. GODART, Frédéric., & WHITE, Harrison. C.. "Switchings under Uncertainty: The Coming and Becoming of Meanings," [Poetics], pp567-86, 2010. Vol 38, No6. Web.

10. HARAWAY, Donna J. [Staying with the Trouble: Making Kin in the Chthulucene], 2016. Duke University Press: Durham. Paperback.
11. HARDING, Sandra. [The Postcolonial Science and Technology Studies Reader], 2011. Duke University Press: Durham. Paperback.
12. HOUNTONDJI, Paulin. "Scientific Dependence in Africa Today," [Research in African Literatures], pp5-15, 1990. Vol 21, No3. Paperback.
13. HUA, Zhou., & WEI, Li. "Translanguaging, Identity, and Migration," [The Routledge Handbook of Language and Intercultural Communication, Jane JACKSON Ed.], pp234-246, 2020. Routledge: London. Paperback.
14. JASANOFF, Sheila. [States of Knowledge: The Co-Production of Science and Social Order], 2004. Routledge: London. Paperback.
15. LEEUW, Lerothodi. L. "An Exemplary Astronomical Lesson That Could Potentially Show the Benefits of Multilingual Content and Language in Higher Education," [Multilingual Universities in South Africa: Reflecting Society in Higher Education, Liesel HIBBERT & Christa VAN DER WALT Eds.], pp167-178, 2014. Multilingual Matters: Bristol. Paperback.
16. MACAMO, Elísio. "Urbane Scholarship: Studying Africa, Understanding the World," [Africa], pp1-10, 2018. Vol 88, No1. Paperback.
17. MAVHUNGA, Clapperton. [What Do Science, Technology, and Innovation Mean from Africa?], 2017. MIT Press: Cambridge. Paperback.
18. MCKITTRICK, Katherine. [Dear Science and Other Stories], 2020. Duke University Press: Durham. Paperback.
19. MIGNOLO, Walter. [The Darker Side of Western Modernity: Global Futures, Decolonial Options], 2011a. Duke University Press: Durham. Paperback.
20. ____. "Epistemic Disobedience and the Decolonial Option: A Manifesto," [Transmodernity], pp3-23, 2011b. Vol 1, No2. Paperback.
21. MITCHELL, William JT. 1995. "Interdisciplinarity and Visual Culture," [The Art Bulletin], pp540-44, 1995. Vol 77, No4. Paperback.
22. PARTHASARATHY, Shobita. "Grassroots Innovation Systems for the Post-Carbon World: Promoting Economic Democracy, Environmental Sustainability, and the Public Interest," [Brooklyn Law Review], pp761-787, 2017. Vol 82, No2. Paperback.
23. ____. "Innovation Policy, Structural Inequality, and COVID-19," [Democratic Theory], pp104-109, 2020, Vol 7, No2. Web.

24. RASHIED, Naiefa., & BHAMJEE, Muaaz. "Does the Global South Need to Decolonise the Fourth Industrial Revolution?," [The Disruptive Fourth Industrial Revolution, Wesely DOORSAMY, Babul Sena PAUL & Tshilidzi MARWALA Eds.], pp.95-110, 2020. Springer: New York. E-book.
25. SIDDLE, Julian. "The 'Next Einstein'? She's From Africa," [BBC News], N.P, April 2016. October 2020. Web.
26. SOUTH AFRICAN RADIO ASTRONOMY OBSERVATORY (SARAO). "Media Release: SARAO Mandated to Manage the Production of Respiratory Ventilators," N.P, 2020. October 2020.Web.
27. STENGERS, Isabelle. [Cosmopolitics], 2010. University of Minnesota: Minneapolis. Paperback.
28. TAKEUCHI, MA., SENGUPTA, P., & SHANAHAN, M. "Transdisciplinarity in STEM education: a critical review," [Studies in Science Education], pp213-253, 2020. Vol 2. No 56. Web.
29. VAZZA, Franco., & FELETTI, Alberto. "The Quantitative Comparison between the Neuronal Network and the Cosmic Web," [Frontiers in Physics], N.P, 2020. Vol 8, No491. Web.
30. WEBB, Paul. "Xhosa Indigenous Knowledge: Stakeholder Awareness, Value, And Choice," [International Journal of Science and Mathematics Education], pp89-110, 2013. Vol 11, No1. Paperback.
31. WELTMAN, Amanda. "Cosmology with Fast Radio Bursts," [South African Astronomical Association Virtual Symposium], N.P, October, 2020. October 2020. Web Video.
32. WIJNGAARDEN, Vanessa., & IDAHOSA , Grace. "An Integrated Approach towards Decolonising Higher Education: A Perspective from Anthropology," [Decolonisation of Higher Education in Africa: Perspectives from Hybrid Knowledge Production, Emnet Tadesse WOLDEGIORGIS, Irina TURNER & Abraham BRAHIMA Eds.], pp36-59, 2020. Routledge: London. Paperback.
33. WILD, Sarah. "South Africa's Top Scientists Have Been Put in Charge of Manufacturing 10'000 Ventilators By June" [Business Insider SA], N.P, April 2020. October 2020. Web.

African Ethics and Online Communities: An Argument for a Virtual Communitarianism

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Abstract
A virtual community is generally described as a group of people with shared interests, ideas, and goals in a particular digital group or virtual platform. Virtual communities have become ubiquitous in recent times, and almost everyone belongs to one or multiple virtual communities. The onset of the COVID-19 pandemic, with its associated national lockdowns, has made virtual communities more essential and a necessary part of our daily lives, whether for work and business, educational purposes or keeping in touch with friends and family. Given these facts, how do we ensure that virtual communities become a true community qua community? We address this question by proposing and arguing for a 'virtual communitarianism'—an online community that integrates essential features of traditional African communitarianism in its outlook and practice. The paper's position is that virtual communitarianism can make for a strong ethical virtual community where members can demonstrate a strong sense of group solidarity, care and compassion towards each other. The inclusion of these virtues can bring members who often are farapart and help create a stronger community bond. This will ensure that the evolution of virtual communities does not happen without the integration of progressive African communitarian values.
Keywords: African ethics, Online communities, African communitarianism, Virtual communitarianism

Introduction

Some people perceive the rapid technological growth on the African continent as a cause for significant concern. Abanyam, for instance, laments that not all Western technologies are hospitable or agree with African ontology or vision. His disquiet lies in the fact that some of what he calls, Western technologies, have contributed to the deterioration of esteemed African cultural values

(2013, 26). Whereas Abanyam's abhorrence for Western technologies may be valid in some respect (for there are indeed observable evidence to the fact that some traditional values are losing their essence due to the influence of Western technologies), the technologies that facilitate virtual communities need not be regarded as a danger to traditional African cultural values and practices. Virtual communities can facilitate and augment prevailing African values and practices, but doing so will require a deliberate and concerted effort.

Virtual communities have become ubiquitous such that almost everyone belongs to one or multiple communities. The onset of the COVID-19 pandemic, with its associated national lockdowns, has made digital communities more essential and a necessary part of our daily lives, whether for work and businesses, educational purposes, religious purposes, social or political activism, or just keeping in touch with friends and family. Although 'real' or geophysical communities and virtual communities share some similar attributes, there are notable differences. For example, while people are born into an already existing geophysical community, the same cannot be said of virtual communities. Individuals join virtual communities of their choosing, and they are more often than not relatively easier to join or leave. Again, unlike geophysical communities, digital communities need not have a physical location or address. There is no material edifice, and its members need not have regular or any face-to-face interaction. Nevertheless, it is possible for a community to exist geo-physically and also online, as in, for example, the creation of a digital platform for a particular neighbourhood to share ideas and decide on projects or workers of a particular company forming an online group to discuss work-related issues. In this regard, and perhaps more, we can say that there sometimes exists an interconnection between virtual and geophysical communities, whereby one supplements the other.

It may be argued that traditional geophysical communities have a stronger sense of bonding and belonging, more especially on the African continent, where much of traditional community life exists due to regular physical interaction. There is also no denying the fast-growing popularity of virtual communities in Africa, with Africa's budding youth making up a large chunk of their membership. Cobigo, Martin, and Mcheimech point out that understanding what it means to be a community has advanced and transformed with the progression of human interactions and behaviours (2016, 183). Thus, we are of the view that virtual community is the next stage in this community transformation. It is, therefore, essential to focus on these emerging virtual communities in Africa and how to consolidate them through the incorporation of values found within traditional African communitarianism that have been the backbone of traditional communities in Africa. In other words, the paper assesses how aspects of traditional African communitarian ethics can be incorporated into existing and emerging digital communities in what we call virtual communitarianism. This is mostly missing in the literature, which tends

to rather speak more on how to make online communities more user friendly, accessible or better designed, or how businesses can use them to gain a competitive advantage (see, for example, LAZAR and PREECE 1998; FISHER 2018).

To achieve its objective, the paper will from here explore the notions of community and virtual digital community. This will be followed by a brief exposition of some of the main features of traditional African communitarianism and ethics. These will pave the way for the argument for virtual communitarianism. The paper is a theoretical analysis and, as such, relies essentially on already existing literature.

Defining Community

An online community, web community, internet community, virtual community, or digital community is a complex notion to define. The difficulty here lies essentially in the open nature of the word community. As Constance Elise Porter (2004) notes, the word 'community' can have different meanings for different individuals, making it difficult to come to a single universally accepted definition. Indeed, Porter intimates that there is possibly close to one hundred definitions of community out there. Interestingly, the only common thing found among all of these different understanding of community is the word *people* (COBIGO, MARTIN, and MCHEIMECH 2016). Diaz (2000) describes community as a concept with a messy history and notes that many social scientists have resorted to disregarding the concept as an ideological mystification due to the numerous complications it faces in defining it. Irrespective of the many conceptions of community out there, it is apparent that 'community' goes beyond a mere amalgamation of individuals. The meaning and scope of the concept of community is not static but rapidly expanding. With the advent of digital platforms, the notion of community has expanded beyond what we already know.

In their review of forty publications, Cobigo, Martin and Mcheimech (2016) discovered some common themes that run through the various definitions of community. Among these themes is the idea of *physical proximity*, which they claim is expressed in terms of "neighbourhood and geographical location." (2016, 189) Related to the theme of physical proximity is the term *bounded*, which they explained as indicating boundaries that separate one community from another. This understanding of community which identifies a group as a community based on its geophysical location, physical territory or boundaries, makes sense for a geophysical community like the Akan community in Ghana or the Zulu community in South Africa. In this sense, we can locate the said community on a map. However, this notion of community is not without its challenge because, as Bartle (2010) correctly points out, a community is not just the individuals found within that geographical territory at a particular point in time.

A community's membership may include others who, although not physically present within the geographical location at a particular point in time, identify themselves with the group and may have temporarily moved to other locations either to return or never to return. Thus, Porter notes that the notion of community entails "both something structural (e.g., a bounded location) and something socio-psychological (e.g., a sense of shared values developed through interaction with members)" (2014, n.p). These two features, i.e., structural and socio-psychological, we suppose, must go together in the traditional sense of community (that is, a community identifiable by the geographical space it is found). Nevertheless, it will appear that socio-physical attributes that involve a sense of shared values developed through meaningful interactions among members hold a community together even beyond a physical territory. Thus, although a physical territory can deliver values such as a high sense of belonging among members and even facilitate regular interaction among members, these values are not to be automatically found, if the individual members do not make the effort required to create them.

Another theme identified in Cobigo, Martin and Mcheimech's project is the use of the terminologies, *shared ties*, *common interests*, and *common identity* in some definitions of community. These terminologies tend to suggest that a community qua community is one that members believe in and uphold and in which they share certain common traits that they hold in high esteem, reverence and respect. Thus, to be a community member would suggest that the individual generally subscribes to these shared ties, interests, identity, values, beliefs, practices, and philosophies. They must hold the group's ideologies, doctrines, dogmas, norms, objectives, goals, aspirations, dreams, vision, and mission as valid and actual. A related theme here is the *sense of belonging*, that feeling of strong affiliation that community members have towards the community or group. With this sense of belonging, members feel accepted and connected to the group emotionally, intellectually, spiritually, among others depending on the group's purpose and function. Understanding community in this sense does not require a community to be physically located. We can speak of a community of liberal philosophers or socialist political theorists in this regard.

A third and striking theme that Cobigo, Martin and Mcheimech's (2016) review of existing literature on the notion of community revealed is the frequent reference to some *regular interaction among members* of a said community. Of course, this should not be surprising because it will be bizarre to think of a community with no interactions among members. Interactions, by way of communication and exchange of ideas, keep fellowship in any community alive. Interactions coagulate interconnectedness and the sense of belongingness. These interactions accentuate another identifiable theme by the authors within the various understandings of community, namely; the suggestion that a sense of community must include a show of support such as

solidarity, *cooperation*, and *assistance*. These are very crucial features of any active community for without them, a community would be latent and lifeless. Members of a community work together in achieving their common objective. They show solidarity with each other and offer their services to the group when required.

Some have compared the community to a living creature, consisting of diverse components with distinctive roles, activities, or interests, each operating within specific boundaries to meet community needs (CLINICAL AND TRANSLATIONAL SCIENCE AWARDS CONSORTIUM 2011). Similarly, Bartle (2010), again, urges us to consider a community as a sort of well-organized living organism. According to him, a community remains alive even though its human members come and go, are born or die. The analogy made between a community and a living creature or organism is an important one because it underscores the continuous functioning roles community members must play to keep the community alive. Thus, just as a living creature requires food and water to keep alive, so must a community maintain its bond to stay alive.

On Virtualness

Although much of the literature focuses on geographical location or proximity in their community classification, others acknowledge the emergence of a borderless community held together not by their shared territory but by their shared common interests. These shared interests may include but are not limited to dating (as you may find on Tinder), employment or professional interests, religious, and even old students associations and alumni. These communities' existence is made possible through virtual or social platforms powered by the internet. Members of these online community groups join and connect regardless of geographical location. Cobigo, Martin and Mcheimech (2016) describe such a community as *a territory-free web-based community* or virtual community.

Porter defines a virtual community as "an aggregation of individuals or business partners who interact around a shared interest, where the interaction is at least partially supported or mediated by technology and guided by some protocols or norms" (2004, np). This definition highlights three significant features of a virtual or digital community; 1. There is the interaction of members 2. These members have shared interests, which is what brings and binds them together, and 3. The use of technology facilitates the community's existence and function. As acknowledged by Porter, although virtual communities are aided by technology, they need not be entirely web-based. Virtual communities can have unequal degrees of 'virtualness'. In what she also describes as fluid communities, Porter explains that digital community members may choose to interact through face-to-face encounters or the use of technology.

Porter further identifies what she calls two first-level categories of a virtual community, i.e. member-initiated and organization-sponsored virtual communities. By member-initiated communities, she means such virtual communities that are established by and remain managed by members. By organization-sponsored communities, she refers to digital communities that are established by either commercial or non-commercial organizations. For this paper's purpose, reference to a virtual community will not apply to organizational-sponsored virtual communities. Thus, the paper's proposal for virtual communitarianism may not apply directly to a business-oriented virtual community whose sole aim is to expand its customer base for profit or use the community as a channel for the advertisement of products and services. As Porter admits, content is less social in these business-oriented or organization-sponsored virtual communities due to the community's commercial orientation. The paper's proposal for virtual communitarianism is more directed to what could be described as member-initiated digital communities, which are more social in their orientation and mimic some aspects of geophysical communities, such as having common shared interests, social relationships, and some form of common identity.

Virtual communities need not be all formal. Quite a number of them are informal or semi-formal. While some have stipulated goals, mission and vision, the vast majority of these communities either do not have any clear goals and missions or their missions are not officially stipulated, although they may be implicitly or tacitly assumed. Some virtual communities have well-defined leaders with well-defined portfolios, while others do not. Again, some of these online communities are meant to be temporal, while others are permanent. Some permanent communities have fixed and permanent membership, while others, although permanent, do not have permanent or fixed membership. Thus, the dynamics of a virtual community can vary.

An important distinctive feature of a digital community that set it apart from geophysical communities is the fact that it is possible that all the members of a digital community may never have seen each other or will never see each other physically or in person. What binds them together is more of what Porter (2004) had described earlier as socio-psychological, that is, their shared interest. This shared interest facilitates the group's interaction and makes the community worthwhile. One need not relocate to join a digital community as one may do for a geophysical community. Instead, one only needs access to the internet and membership can be conferred based on the community's terms and conditions.

It may be argued that constant physical interaction is vital for establishing community bonds and solidarity, and as such, geophysical communities will have an advantage over virtual communities. This can be granted; however, what virtual communities lack in physical interactions, they

more than compensate for in a stronger shared interest. This is because virtual community members are not automatic members of their group by virtue of birthplace or place of settlement. They join these communities on their own due to the groups' appealing socio-psychological factors. Hence, they are expected to have a higher sense of belonging, participation, and engagement.

The technology for creating and sustaining online communities has become easier to use, far accessible and more convenient, hence contributing to the growing widespread popularity of digital communities. Of course, this is augmented by the fast-changing city lifestyle that does not afford city dwellers much time on their hands for physical gathering and socialization as frequently as they may wish. With virtual communities, members can connect using applications like Yammer, webinars, discussion forums, blogs, and other online social media spaces such as WhatsApp, Facebook, Twitter, and Instagram in the comfort of their home, while in transit or anywhere else they find themselves. The only things needed are a working internet and a smartphone or computer.

Online communities also can be more participatory and engaging since every member can equally be a content creator directly and instantly, advance their views on matters of concern and directly take part in votes and debates without the need for representatives. Similarly, since information shared is received directly by all members almost simultaneously, members are more readily informed than members who are part of geophysical communities. These advantages of virtual communities allow members to learn from each other and promote community participation and involvement.

Since geographical boundaries do not limit them, virtual communities often tend to be more multi-cultural and diverse. This, of course, can have both positive and negative impacts on the community's overall function. Nevertheless, when well-managed, these features can be harnessed for the overall benefit of the group. There is the danger of having a multiplicity of group interests within such a virtual community with different interests other than the overarching group interest. This can become destructive and a nuisance in the group. This feature is often the hallmark of large virtual communities. This notwithstanding, scholars like Storchi (2015) believe that the size of the community in terms of their membership ought not to be a drawback on virtual communities insofar as engagement is sustained. This is because the strength of virtual communities lies in their 'human-to-human connection' and their capacity to initiate content of interests to their members.

African Communitarianism and Ethics

Communitarianism

African societies are communitarian, and even though the different communities are not homogenous, they share similar ideology, values, and practices in many ways. Within this communitarian system, more emphasis is placed on the community than on individuals. In describing the communal nature of the African society, Coetzee and Roux (1998, 320) explains that it is:

> A group of persons linked by interpersonal bonds, biological and/or nonbiological, who consider themselves primarily as members of the group and who have common interests, goals and values. The notion of common interest and values is crucial to an adequate conception of community, the notion in fact defines the community. It is the notion of common interest, goals and values that differentiate a community from a mere association of individual persons. Members of a community share goals and values. They have intellectual and ideological, as well as emotional, attachment to those goals and values; as long as they cherish them, they are ready to peruse and defend them.

To Coetzee and Roux, a communal society is where individuals share and are guided by a common set of goals and values. Therefore, to be an accepted member of this community or deemed a 'person' in this community, one must have certain qualities and attain specific standards laid down by the group. Being communal suggests a communion of souls in which the individual is considered part and parcel of the community (SENGHOR 1964, 24). Importance is given to individuals' responsibilities towards the community as opposed to individual rights. Hence, the community takes precedence over the individual. Senghor affirms that "Negro-African societies put more emphasis on the group than on the individual, more on the solidarity than on the activity and needs of the individual, more on the communion of persons than on their autonomy. Ours is a community society" (1964, 93-94). So, rather than highlighting individuality, African communitarian societies place more importance on the community.

Discussions on the individual's place within the African communitarian society continue to be topical among most African philosophers and ethicists. Three schools of thought have emerged out of these discussions, namely radical, moderate and limited communitarianism. Scholars such as Mbiti (1970), Tempels (1959), Menkiti (1984), and Senghor (1964) are among those who hold the radical communitarian view that the reality of the African communal world ought to take precedence over the reality of the individual's life and choices. To these philosophers, defining the individual in reference to the community suggests that the individual acquires 'personhood' not at birth but much later in life, and depending on his or her relationship with the community. It is the position of Mbiti (1970) that an individual from a communitarian background has no existence outside the community because the community defines him or her. This school of thought is what Gyekye (1997) refers to as radical communitarianism.

In objecting to the radical communitarian view, Gyekye (1997) and Eze (2008) proposed what they call moderate communitarianism. This view emphasizes that there is an interrelationship between the individuals in the community. For Eze, the individual and the community co-exist (2008, 386). The argument behind moderate communitarianism is that it was proposed to bring a sense of balance between the influence of community and individual independence. According to Gyekye "moderate communitarianism aims to ascribe to both the community and the individual an equal moral standing" (1997, 41). It suggests that rights and responsibilities have equal status and that the community does not take priority over the rights of an individual. Matolino, on the other hand, raises a concern on both radical and moderate communitarianism, and argues for what he calls limited communitarianism. To him, the individual in both radical and moderate communitarianism is not given the attention he or she deserves. He believes that the individual ought to take precedence over the community (2014, 161). He affirms that "individuals are entities and that they are worthy of respect as a creation of God and one whose identity proceeds from God" (MATOLINO 2014, 161).

The paper does not intend to extend or do an elaborate discussion on the role or extent of community in the lives of the individual in traditional African communitarian societies. For this paper, whether African communitarianism is described as radical, moderate, or limited, the crucial thing here is that traditional African societies place emphasis on group bonding and an active community life.

The Ethics of Communitarianism

As noted earlier, sharing community life suggests that the community shares several principles and values, and adherence is prominent. Some of these shared principles and values within the communitarian setting include the following, "*Ubuntu*, charity, honesty, hospitality, generosity, loyalty, truthfulness, solidarity, and respect for nature, elders and God" (KINOTI 1992, 84). Kinoti maintains that "honesty, reliability, generosity, courage, temperance, humanity and justice, and social values that helped society to remain integrated, like peace, harmony, respect for authority, respect for and fear of supernatural realities" (KINOTI 1992, 80) are the features of communitarian societies. According to Gyekye these virtues apply as well: "kindness, compassion, sympathy, concern for others—in short, any action or behaviour that is conducive to the promotion of the welfare of others" (1998, 324). These are the features that culminate the African philosophy of *ubuntu*.

Johann Broodryk defines *ubuntu* as "a comprehensive, ancient worldview which pursues primary values of intense humaneness, caring, sharing and compassion, and associated values, ensuring a happy and quality community life in a family spirit or atmosphere" (BROODRYK 2004, 4).

Ubuntu here suggests a concept that represents the values embedded in what it means to be human. It echoes the worldview and the experiences of the African people, particularly those in the Sub-Saharan region. Mangena describes it as "the ethical benchmark of African societies" (2009, 17), suggesting that it is the deep-rooted standard value that is used to measure human social relationships within most Sub-Saharan African communities. Similarly, Mawere posits that: "Ubuntu is a multi-faceted philosophical system that involves logic, metaphysics, epistemology and ethics; it is a philosophy of life that is concerned with the reinforcement of unity, oneness and solidarity among the Bantu people" (MAWERE 2012, 3).

Argument for a Virtual Communitarianism

Since it does appear that digital or virtual communities are here to stay and perhaps the defining nature of what it means to be a community in the future, it is essential to find ways to make these communities as functional as possible. Virtual communities may eventually take over geophysical communities or become the foremost communities people identify with, even more than the communities where they are physically located. This does not mean virtual communities ought to lose all the features or quality of a physical community. Thus, in what follows in this final section, we make a case for a virtual community that integrates key attributes of African communitarianism.

This is important because, despite many years of change and the influence of globalization, the African communitarian ideology still espouses some essential ethico-cultural values that hold communities and societies together as a whole. As Mintzberg (2009) concisely points out, although there are some great values in individualism such as the promotion of leadership, incentives to work, and encouraging development, humans are essentially social beings who require a social system to function to bring about the greater good. For Mintzberg, this is what the word "community" ought to stand for; that social glue that binds us together for the greater good. Gyekye (1997) similarly points to the attainment of the common good, the good that is collective, shared, universal, and beneficial to all, as the African communitarian society's key objective.

The implication here is that to attain an online community that is communitarian, there is the need to integrate values that rally people together towards the common or greater good of the community rather than going after individual pursuits and agendas. This is more accurate, especially in virtual communities, where one chooses to join a virtual group on their own and not by virtue of place of birth or settlement. Unlike geophysical communities where one can argue that they are members by birth or by location and not necessarily by choice, the same cannot be said of virtual communities whose

memberships are sometimes applied for and a set of conditions must be confirmed before membership is conferred. Thus, if one is a member of a virtual group, then that is by one's choice and by one's willingness to promote the interests of the community and embrace its values. As such, there are much more compelling reasons for members of virtual communities to seek and work towards the common or greater good of their communities e than in a geophysical community.

Furthermore, the need for virtual communitarianism is underscored by what is recognizable as the online community's ills and evils. This is characterized by online bullying, hate speech, online stalking, identity thefts, and impersonation. It is our strong conviction that these African communitarian values and features, when judiciously incorporated in virtual communities' structures, would make virtual communities ethically robust and sustain their existence.

What then are these values from the traditional African communitarian attitude that need to be assimilated in these emerging digital communities to move them from a mere amalgamation of individuals on a digital platform to an actual virtual community qua community? To answer this, the paper takes a look at how African communitarianism defines or understands community, as expressed here below by Gyekye:

> [Communitarianism] sees the community as a reality in itself—not as a mere association based on a contract of individuals whose interests and ends are contingently congruent, but as a group of persons linked by interpersonal bonds, which are not necessarily biological, who consider themselves primarily as members of a group and who share common goals, values, and interests. (1997, 41-42)

Interestingly, Gyekye, in the quote above, did not allude to the idea of a geographical location in his definition of a communitarian community. This makes his definition extendable to virtual communities, insofar as such a community, although aided by modern digital technology in this instance, can imbibe essential communitarian values and features. These features are explained again by Gyekye below:

> The notion of shared life—shared purposes, interests, and understandings of the good—is crucial to an adequate conception of community. What distinguishes a community from a mere association of individuals is the sharing of an overall way of life. In the social context of the community, each member acknowledges the existence of common values, obligations, and understandings and feels a commitment to the community that is expressed through the desire and willingness to advance its interests. (1997, 42)

From the above, it is evident that the African communitarian conception of community is centred on shared interests and purpose. These are features that do not require a geophysical boundary to work. Indeed, as it has already been said, virtual communities are better placed to attain shared purpose and interests due to how information is readily accessible to their members and the voluntary membership feature of virtual communities. However, there is more; shared interests imply common values which impose some obligations and commitment on all members. For Gyekye, members of a communitarian society are required to demonstrate concern for each other's well-being, do their best to improve upon each other's well-being, pursue the common good, and overall, be involved in community life. Also, some sense of loyalty is highly desired from members to the community's cause or agenda.

The paper had in the previous section referred to some of the ethical values esteemed within the African communitarian outlook. These include, as Mawere (2012) correctly notes, unity, oneness and solidarity. These virtues are highly necessary to entrench the sense of community that African communitarian societies are well noted for. They are what ensures a high sense of belonging and uniformity of purpose. Solidarity breeds compassion and empathy, a feeling that makes one identify with the needs and sufferings of others and move them to act to alleviate the plight of others.

What do these mean for the virtual communitarianism we are proposing? The agenda to incorporate communitarian features and ethics, namely shared and sustained interests and purpose, obligation, commitment, solidarity, unity, and oneness into virtual communities will require much time to cultivate and mature. An online group can be formed in minutes but creating a virtual community fashioned around these essential African communitarianism values does not occur instantly. As virtual community members participate in the group's shared experiences, they begin to build trust that leads to codependency. Solidarity must be cultivated and motivated for the sustainability of the group. Members of a virtual communitarian society must not be concerned with their affairs and interests only. They must show commitment to group efforts and the needs of each other. It is important, especially for socially oriented virtual communities to do this because it is the show of solidarity that binds them in unity and oneness of purpose and sets them apart from a business or an intellectual virtual community, where relation does not go beyond business or academic matters.

We shall describe virtual communitarianism as an online community that integrates essential features of traditional African communitarianism in practice and outlook. Since communitarianism generally underscores the community's supremacy over the individual, a virtual communitarian theory also must stress group interest over that of the individual. That is what can sustain the continuous functioning of the virtual community. The shared

interest in the virtual community is solidified through solidarity and shared responsibilities. This means that members of a virtual community must contribute money or any form of resources if the group requires it, perhaps for a project that ensures to the group's benefit. This may be in the form of monthly or periodic contributions. Every member must step up for others when the group sees the need to do so, while selfish and greedy behaviours must be condemned and eschewed. Just as laziness and constant begging are abhorred in traditional communitarian societies, people who exhibit such behaviours must be exposed and admonished.

If a community will thrive, each member has to perform their part with respect to the whole organism efficiently. A strong community has well-connected, codependent members that share obligations for identifying and solving problems and improving its well-being (CLINICAL AND TRANSLATIONAL SCIENCE AWARDS CONSORTIUM 2011). Given all these, perhaps Mintzberg (2009) was spot-on in claiming that a vibrant [virtual] community is one where talented people are loyal to one another, and their collective work, where everyone feels that they are part of something extraordinary, and their passion and accomplishments make the community a magnet for talented people. Similarly, the theory of virtual communitarianism this paper is defending agrees with Mintzberg's position that the decisive indicator of whether a [virtual community] has attained a true sense of community is whether its members consider themselves as responsible citizens of the broader community.

Conclusion

The paper proposes a theory of virtual communitarianism, an online community that integrates essential features of African communitarianism in its orientation, outlook, practices, and ideals. We have expressed that some of the essential African communitarian values easily transferable unto existing and emerging virtual communities are solidarity, cooperation, and shared responsibilities. These values, we have argued, build trust, and foster a stronger sense of belonging among members of virtual communities. We have reasoned that it is essential for virtual communities to incorporate these virtues because membership here is not necessarily based on geophysical location, neither is interest sustained based on the regularity of members' physical contact. The multiplicity and diversity of the membership of virtual communities is profound. Thus, the inclusion of these communitarian virtues can bring members who often are far apart closer and help create a stronger community bond. The overarching goal of the paper's proposal is to ensure that the transition of geophysical communities into virtual communities does not happen without the integration of sound and positive African communitarian values.

Relevant Literature

1. ABANYAM, Noah L. "The Effects of Western Technology on African Cultural Values" [IOSR Journal of Humanities and Social Science (IOSR-JHSS)], pp26-28. 2013. Vol. 8, Issue 4. Web.
2. BARTLE, Phil. "What Is Community? A Sociological Perspective," [Wordpress.com] 2010. Retrieved March 2021. https://edadm821.files.wordpress.com/2010/11/what-is-community.pdf
3. BROODRYK, Johann. [Ubuntu: Life Lessons from Africa], 2002. Ubuntu School of Philosophy: Pretoria.
4. Clinical and Translational Science Awards Consortium Community Engagement Key Function Committee Task Force on the Principles of Community Engagement. 2011. [Principles of Community Engagement], Second Edition. 2011. NIH Publication No. 11-7782. Retrieved March 2021. https://www.atsdr.cdc.gov/communityengagement/pdf/PCE_Report_508_FINAL.pdf. Web.
5. COBIGO, Virginie, MARTIN, Lynn & MCHEIMECH, Rawad. **"**Understanding Community" [Canadian Journal of Disability Studies], pp181-203, 2016. Vol 5, No 4.
6. COETZEE, P.H. & ROUX A.P.J. Eds. [The African Philosophy Reader], 1998. Routledge: London. Paperback.
7. DIAZ. P. "Definitions of Community," [Uregina.ca] April, 2000. http://uregina.ca/~sauchyn/socialcohesion/definitions%20of%20community.htm**.** Web.
8. EZE, Michael. O. "What is African Communitarianism? Against Consensus as a regulative ideal,". [South African Journal of Philosophy], pp386-399, January, 2008. Vol 27, No 4. Paperback.
9. FISHER, Greg. 2018. "Online Communities and Firm Advantages," [The Academy of Management Review], pp1-53. Vol 44, No 2. DOI: 10.5465/amr.2015.0290. Web.
10. GYEKYE, Kwame. [Tradition and Modernity: Philosophical Reflections on the African Experience], 1997. Oxford University Press: New York. Paperback.
11. _____. "Person and Community in African Thought," [Philosophy from Africa P.H. COETZEE & A.P.J. ROUX Eds], pp317-336, 1998. International Thomson Publishing: Johannesburg. Paperback.
12. KINOTI, H. W. "African Morality: Past and Present," [Moral and Ethical Issues in African Christianity J.N.K. MUGAMBI,. & A. NASIMIYU-WASIKE Eds], pp73-82, 1992. Initiatives: Nairobi.
13. LAZAR, Jonathan & PREECE, Jennifer (1998) "Classification Schema for Online Communities" [Paper Presented at the Association for Systems Americas Conference (AMCS), Baltimore, Maryland, 1998]. https://aisel.aisnet.org/amcis1998/30. Web.

14. MANGENA, Fainos. "The search for an African feminist ethic: A Zimbabwean perspective," [Journal of International Women's Studies], pp17-30, 2009. Vol.11, No.2.
15. MASOLO, D. A. [Self and Community in a Changing World], 2010. Indiana University Press: Indiana. Paperback.
16. MATOLINO, Bernard. [Personhood in African Philosophy], 2014. Cluster Publications: Dorpspruit, South Africa. Paperback.
17. MAWERE, Munyaradzi. "Buried and Forgotten but not Dead: Reflection on "Ubuntu" in Environmental Conservation in South-Eastern Zimbabwe." [Afro-Asian Journal of Social Sciences], pp1-20. 2012. Vol 3, No 3-2.
18. MENKITI, Ifeanyi. A. "Person and Community in African Traditional Thought," [African Philosophy: An Introduction R. A. Wright Ed.], pp171-181, 1984. University Press of America: Lanham. Paperback.
19. MINTZBERG, Henry. "Rebuilding Companies as Communities," [Harvard Business Review], July-August 2009. https://hbr.org/2009/07/rebuilding-companies-as-communities&cm_sp=Article-_-Links-_-Top%20of%20Page%20Recirculation. Web.
20. MBITI, John. S. [African Religions and Philosophies], 1970. Anchor Books: New York.
21. PORTER, Constance. E. "A Typology of Virtual Communities: A Multi-Disciplinary Foundation for Future Research," [Journal of Computer-Mediated Communication], November, 2004. Vol 10, Issue 1 4. https://doi.org/10.1111/j.1083-6101.2004.tb00228.x**.** Web.
22. SENGHOR, Leopold S. [On African Socialism], 1964. Praeger: New York.
23. STORCHI, Paola "Online Communities: Connecting Online to Improve a Shared Practice and to Spark Innovation" [Unicef.org] September 2015. https://sites.unicef.org/knowledge-exchange/files/Online_Communities_production.pdf**.** Web.
24. TEMPELS, Placide. [Bantu Philosophy], 1959. Presence Africaine: Paris. Ebook.

Gender and Humanoid Robots: A Somaesthetic Analysis

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Abstract
I discuss in this paper how robotic scientists tend to produce replicas of human bodies that are consistent with their own cultural norms by exploring how gender is embodied in humanoid robots. My focus is specifically on care robots, and their reception in the African context. I argue that since the bodies of the robotic scientists are the reference points according to which they design and manufacture robots, a somaesthetics of robotics can best reveal and challenge how gendered norms are materialised in these machines.
Keywords: Care robots, Somaesthetics, Robot body design, Gender, Uncanny valley, Persona effect.

Introduction

A robot is an engineered machine that has "sensors, processing ability that emulates some aspects of cognition, and actuators" (LIN, ABNEY & BECKEY 2011, 943). The word was coined by Czech playwright Karel Čapek, in his 1920 play *Rossum's Universal Robots*. In the context of Čapek's play, the word refers to forced labour (DIXON 2004, 16).[1] Čapek's vision has indeed been fulfilled, with a myriad of robots currently being deployed to perform the "three ds" - activities that are, for humans, "dull, dirty, and/or dangerous" (DINET AND VIVIAN 2014, 105).[2] Yet, unlike robots that complete tasks in factory and warehouse assembly lines, humanoid robots are designed to resemble or mimic the human body (in part or as a whole), and are intended to interact closely with humans in social contexts. One kind of social robot is the professional assistance or "care" robot. This kind of robot is designed, for example, to complete medical or bodily care tasks, or social tasks such as engaging in conversation or providing directions. Care robot sales have increased by 32 percent ($11.2 billion) worldwide over the last two years (GUEVARRA 2021, n.p.). In addition, their appeal has increased dramatically during the COVID-19 pandemic due to their ability to safely complete tasks such as disinfecting surfaces, monitoring patients' vital signs, and delivering

[1] Steve Dixon (2004) provides an excellent and detailed history of the robot.
[2] In car assembly, for example, the deployment of robots means that human workers do not have to be exposed to noxious fumes from welding and painting. In addition, human workers are no longer at risk of retinal damage from weld flash or auditory damage from the noise of stamping presses.

supplies (GUEVARRA 2021, n.p.). With these machines rapidly becoming part of everyday life, the question then arises: does the design of robot bodies have any ethical import? If so, in what sense?

Since the lion's share of the current literature focuses on the ethics of the *programming* of AIs[3], this paper finds its significance in shifting attention to the embodied[4] nature of robots, and specifically to the intertwined nature of the ethics and aesthetics of their design using a somaesthetic approach. Specifically, I discuss in this paper how robotic scientists design robots in ways that are consistent with their own cultural norms, focusing on how gender is being embodied in some humanoid robots.[5] My focus is specifically on care robots, and their reception in the African context. I suggest that since the bodies of the robotic scientists are reference points for the machines they design and manufacture, a somaesthetics of robotics can best reveal and challenge how gendered norms are materialised in the machine.[6]

Somaesthetics, a philosophical approach coined by pragmatist philosopher Richard Shusterman, is "[c]oncerned with the critical study and meliorative cultivation of how we experience and use the living body (or soma) as a site of sensory appreciation (aesthesis) and creative self fashioning" (SHUSTERMAN 2008, 1). This paper is an exercise in pragmatic somaesthetics – one of the three dimensions of somaesthetics that Shusterman (1999) demarcates. Pragmatic somaesthetics "has a distinctly normative,

[3] There are certainly exceptions to this, for example, Keller and Longino (1998) and Lamola (2021) focus on robots and gender, Hess (1995) focuses on race and Helmreich (1988) focuses on sexuality. However, none of these theorists employs a somaesthetic approach as I do here.

[4] Using the term "embodied" in the context of robots is not an innocent choice. I use the word "embodied" when referring to humanoid robots because I do not uphold a restrictive notion of embodiment that limits cognition to organisms, i.e. living bodies. Maturana & Varela (1980, 1987) and Ziemke & Sharkey (2001) are examples of theorists who do argue that there is a difference between living organisms, which they contend are autonomous and autopoietic, and human-made machines, which they contend are heteronomous and allopoietic. I reserve an extended discussion of this exceptionally important thematic for another occasion.

[5] Due to space limitations, my focus is only on gender in this paper, even though the phenomenon could rightly be called intersectional, traversing the lines of gender, race, class, and sexuality. Intersectionality means that "one's identity too rich and complex to be captured by a single category" (HAMINGTON, 2015:86) Significantly, a number of theorists have investigated how racialized regimes underpin computational systems and machine learning, including Hess (1995), Buolamwini and Gebru (2018), Noble (2018), and Benjamin (2019).

[6] Lamola (2021) uses the case of black women in Africa to argue for the importance of ethical responsibility in the building of robots. Lamola highlights the semiotic, phenomenological and psychical suggestive influences of robots in order to argue his point. The argument I present in this paper is premised on the significance of the somaesthetic dimension of human existence, and so differs significantly from Lamola's approach.

prescriptive character – by proposing specific methods of somatic improvement and engaging in their comparative critique". (SHUSTERMAN 1999, 304-305).

The paper is structured as follows: I begin by briefly setting out some of two of the complexities that arise with humanoid robots and their design – (1) navigating the space between the "uncanny valley" and the "persona effect"; and (2) navigating the reproduction of gendered (and other[7]) norms. I then proceed to discuss some examples of care robots and analyse the body aesthetic that emerges using a somaesthetic approach. Here, I show how the cultural realities of roboticists are embodied in the machines they design and manufacture, focusing specifically on the embodiment of gender. In the third and final section, I suggest how a somaesthetics of robotics can be used to avoid the normalisation of gender bias in gendered humanoid robot design.

The Complexities of Designing Humanoid Robots

New generations of robots are being designed to perform human tasks such as caring for the sick, for children (such as PaPeRo, Wakamaru) or for the elderly (for example Ri-man); performing household tasks; and providing companionship (including ifbot, Pino, Posy, Robovie), conversation or even sex (such as Kaori) (ROBERTSON 2007: 372-373, cf. SULLINS 2012). A central issue in the development of these robots is the question of embodiment, since it is not only humans, but also robots, that are "enabled and constrained" by their bodies (MOORE 2012, 53).

The complexity of how embodiment affects human-machine interactions is, I think, revealed in the ambivalent space between two phenomena mapped out in the literature: the "persona effect" and the "uncanny valley" effect. As Cyr, Hassanein, Head and Ivanov (2007) explain, the "persona effect" is that people's social responses to computers appear to be stronger with more "human"- looking images. In contrast to this, Japanese roboticist Masahiro Mori explains how people experience aversion when robots look very human-like, but their behaviours do not match the humanness of their appearance (MORI 1999). This is the "uncanny valley" – the uncomfortable territory into which humans step back when robots

[7] Richardson (2010, 87) provides a fascinating discussion of how robotic scientists "default to the self" by incorporating disabilities into the robots they create. Richardson's view is that roboticists constantly negotiate their own disabilities and work out their own "psychic and physical dramas" in their robotic creations. (*ibid*.)

look"almost, but not quite human".[8] Designers of robot bodies face the challenge of navigating between these two effects in order to ensure that their robots are accepted into the environments for which they are designed.

The complexity of how embodiment affects human-machine interactions also emerges in how gendered norms are reproduced in the design of androids (male robots), gyroids (female robots)[9] or gender-neutral robots[10] - the very focus of this paper. One example that has attracted much attention is Hiroshi Ishiguro's Erica, launched in 2015. Erica is explicitly designed to provide a practical conversation service, with a "'warm, gentle, and caring' affect" (GUEVARRA 2021, n.p.). As Ishiguro notes, he designed Erica to be "beautiful", drawing on images of "thirty beautiful women." (GUEVARRA 2021, n.p.). Erica is unable to move independently, since she consists only of a torso, head and arms. Her hair is long and smooth; her silicone skin is light and flawless; her voice is soft and high; and her gaze is gentle and avoidant. As such, her embodiment conforms to the established aesthetic view of the female body as weak and passive. Under this view, women should "…speak softly, eat daintily, sit with closed legs, and walk with bowed heads and lowered eyes" (SHUSTERMAN 2003:112). In addition, as Alač, Movellan and Tanaka (2011, 894) point out,

> the robot's social character extends beyond its physical body, to include multimodal interaction within everyday routines. The robot's social character thus includes its positioning in the space and the arrangement of other actors around it, as well as its interlocutors' talk, prosody, gestures, visual orientation, and facial expressions.

[8] In "Blurring Human–Machine Distinctions: Anthropomorphic Appearance in Social Robots as a Threat to Human Distinctiveness," Ferrari, Paladino and Jetten (2016) argue that what humans dislike about anthropomorphic robots is their perceived incursion on human uniqueness. For a fascinating treatment of this phenomenon from an unusual perspective, consult Dixon (2004, 17) who argues that "since robots currently fail to accurately mimic human and animal movement, their exaggerated gaits and gestures emphasize the same sense of theatricality and artificiality in movement that we find in camp." Dixon's view is that "[r]obotic movement mimics and exaggerates but never achieves the human, just as camp movement mimics and exaggerates but never achieves womanhood." (DIXON 2004, 17)

[9] See Robertson's (2017) *Robo Sapiens Japanicus: Robots, gender, family, and the Japanese Nation* and Seth Jacobowitz's (2014) "Between Men, Androids, and Robots: Assaying Mechanical Man in Meiji Literature and Visual Culture" for excellent discussions.

[10] Robots like Baxter (BOHANNON 2014, 181), or Stevie (RAMALEPE 2021) are explicitly marketed as gender-neutral.

Erica's design – consisting of only a torso, head and arms reinforces the idea of the passivity of the female by means of using how she must be positioned in space. Already then, we see that, as a somaesthetic approach reveals, "…entire ideologies of domination can be covertly materialized and preserved by encoding them in somatic norms that, as bodily habits, get taken for granted and escape critical consciousness" (SHUSTERMAN 2003,112). This means that even when designers mean no harm,

> [t]he current trends in machine learning augment historical misperceptions of women (meek, mild, in need of protection). Unchecked, they will regurgitate the worst female stereotypes. Sexism will become even more infused within societies as they increasingly- and willingly- rely on advanced technology." (HAYASAKI 2017, 41)

How then does a gendered body aesthetic appear in care robots in the African context?

Care Robots and Gendered Body Aesthetics

In Africa, robots have been employed in a number of modalities for many years, but unlike in Japan, the use of social robots is still relatively rare. I use three examples here in order to provide a basis for a somaesthetic analysis of the gendering of robot bodies. The examples I draw upon are 1) the robot concierges Lexi, Micah and Ariel that are deployed in Hotel Sky in Sandton, South Africa; 2) the five medical care robots deployed at the Kanyinya COVID-19 treatment facility in Rwanda; and 3) Stevie, a mobile medical robot in use at the Steve Biko Academic Hospital, South Africa. What stands out even before I begin my discussion of how these robots are embodied, is that all these robots have been given human names. This is not accidental, since when modelling a robot's social appearance, roboticists name the robot and design its perceivable features to humanize it (DISALVO, GEMPERLE, FORLIZZI & KIESLER 2002). I return to this phenomenon in the discussion that follows.

The three concierges deployed in Hotel Sky are touted as the hotel's response to travellers' increased desire for socially distant interactions in the time of the Covid-19 pandemic. Lexi, Micah, and Ariel can deliver room service, provide travel information, and carry around 300kg of luggage each. The robots each wear their own personalised, multi-coloured outfit, and are described as "fashionistas at heart with a love for trends, hospitality, technology, and South Africa." (POITEVIEN 2021, n.p.). Even though these robots are not designed to emulate the human body in the same way as the robot Erica is, they certainly are gendered in terms of their design. Lexi, for example, is "dressed" in pink paisley and hearts, and has a feminine voice,

meeting guest's stereotypical expectations regarding the gendered distribution of work in the hospitality industry[11].

Interestingly, this overt gendering of the robot is not the case with the five medical care robots donated by the United Nations Development Programme to help frontline workers tackle the coronavirus crisis at Kanyinya COVID-19 treatment facility in Rwanda. The robots, made by Zora Bots, a Belgian robotics company, have been given Rwandan names: Akazuba (meaning sun), Ikizere (meaning hope), Mwiza (meaning beautiful), Ngabo (meaning shield) and Urumuri (meaning light) (UWIRINGIYIMANA 2020, n.p.). They are intended to serve as an interface between doctor and patients, reducing exposure of health workers to the Covid-19 virus. (UWIRINGIYIMANA 2020, n.p.) and are instances of the "Epidemic Edition" of the Cruzr type robot made by Zora Bots.

Even though the bodies of the smooth, white robots with their huge, bright blue eyes, is not explicitly gendered, the Cruzr model is specifically referred to using the masculine pronoun in Zora Bot's online marketing material. In addition to this, the fact that the Cruzrs have white bodies and blue eyes demonstrates, in my view, how the bodies of the robotic scientists are the reference points according to which they design and manufacture their robots. Why?

Hochberg (2020) explains that it was the 19th century advent of antisepsis and evidence-guided medical practices that contributed to the physician's white coat representing "cleanliness, scientific achievement, and professional responsibility." Choosing to give the medical robots white bodies. in this case, could be explained as an allusion to the white coat of the medical professional, but it could also be a choice based on racial bias. As has been shown by a number of theorists, including Bartneck, Yogeeswaran, Ser, Woodward, Sparrow, Wang, & Eyssel (2018), humans perceive robots to have race, and race-related prejudices do extend to robots. The big bright blue eyes given to the robots add to the force of this conclusion, once again showing how the bodies of the makers are reference points for the design and manufacture of robots.

The final example is Stevie, a mobile medical care robot deployed at the University of Pretoria's Faculty of Health Science, and the Steve BikoAcademic Hospital in Pretoria, South Africa. Like the Epidemic Edition Cruzrs, Stevie is touted as a gender-neutral robot, despite being named after male South African anti-apartheid struggle icon Bantu Steve Biko. Stevie is designed to allow ICU specialists from Germany and South Africa to share and discuss medical cases via the robot (RAMALEPE 2021). Stevie (note the

[11] As Parks (2010: 101) points out, the entire structure of community care, relies on a historical model of women as homemakers and caretakers in the private sphere of the home. These models are being reproduced in the way in which robot bodies are being designed.

diminutive form of the name Steve being used here) is the least human-like of the examples that I have discussed, with a privacy handset and stethoscope port (RAMALEPE 2021) set in a boxy, shiny, white exterior, set on a large mobile base. Despite this, Stevie is referred to as "the much-adored baby" of the ICU team (RAMALEPE 2021, n.p.), and so the ease with which users anthropomorphise a machine is evident.[12]

What can a somaesthetic approach contribute to our understanding of the embodiment of these robots, especially if, as I previously mentioned, somaesthetics is concerned with the critical study of how *humans* experience and use their *living* bodies as sites of sensory appreciation and self-fashioning?

Somaesthetics is an essentially interdisciplinary field grounded in philosophy, which is intended to "contest the centuries-long denigration of the body that infected western philosophy and culture" (TAYLOR 2016, 108). As a discipline, it is concerned with both the lived experience of the body, and its external form or representation. As Shusterman explains, somaesthetics has three aspects – the experiential, the representational and the performative (SHUSTERMAN 2008, 26), where representational somaesthetics is concerned "more with the body's surface forms" (SHUSTERMAN 2008, 26). It is from this perspective - the focus on the external form or representation of bodies that Shusterman calls representational somaesthetics, and Paul Taylor (2016) names the *sarkaesthetic* – that the bodies of robots and their impact on humans' lived experience of their own bodies, can be the focus of a somaesthetic investigation in my view. Shusterman himself notes that,

> At this stage in somaesthetics research, we have only been concerned with somatic feelings of human bodies and thus with only one side of the HCI interaction. But, in principle, it may be possible to consider the somaesthetics of nonhuman somas, including computer bodies (SHUSTERMAN, 2013, n.p.)

In my view, a somaesthetic approach reveals both human *and* non-human bodies as malleable sites for the inscription of social power and (in)justice, showing how the somatic norms of dominant ideologies can be insidiously inculcated in those bodies. The somaesthetic focus on the inscription of power in bodies is directly inspired by the writings of French philosopher Michel Foucault. Even though Shusterman is critical of Foucault's work, noting that it has been charged with "narrowness, sensualism, hedonistic triviality and apolitical narcissism" (SHUSTERMAN 2000, 532), Foucault is seen as "exemplary" since he works in all three areas of somaesthetics. Foucault's work also provides a means to develop a way in which the representational can be approached in a meaningful way from the perspective

[12] This tendency to anthropomorphise is not limited to care robots. Robots feel to us like social actors to such an extent that soldiers sometimes jeopardize themselves to preserve the "lives" of military robots in the field (SINGER 2009).

of feminisms, since for Foucault, critique is an essential constituent of the politics of the self (SHUSTERMAN 2000, 532). Critique is a way of maintaining a critical awareness of oneself and one's environment, analysing what Foucault calls the "discourses of truth", and so doing, provides a means for recognising and perhaps resisting forces of power.

If, as I have shown in the examples discussed, ideologies of domination can be covertly materialized in robot bodies, escaping the critical consciousness of designers and users alike, it makes sense to encourage the development of a critical somaesthetic diagnosis of the ways in which robot bodies are designed. Such an approach will allow for the underlying biases that generate them to be exposed and examined, and for designers to take these into account in the design process. Robots, as artefacts, are embedded with cultural constructions of gender (and beauty, race, class and sexuality) and so are not the neutral doubles (HELMRIECH 1998) that scientists might think they are creating. The three examples I have discussed have demonstrated this assertion. What then would such an approach entail?

Addressing the Normalisation of Gender Bias in Robot Bodies

It is of critical importance to point out that even though the design of robot bodies could entrench patriarchy, their use could have just the opposite effect. As Justine Cassell, director of the Human- Computer Interaction Institute, points out, for example, "robots will remove some of the 'thankless labor,' so women can pursue work they truly enjoy or find rewarding, rather than being consigned to stereotypical care- giving jobs" (HAYASAKI 2017, 46).

In terms of the design of humanoid robots, a somaesthetic approach would not assert that gender does not exist or that race is an empty category. Rather, as Anne Ducille eloquently points out, we need to theorise gender (as well as race, beauty, class, and sexuality), not as meaningless but as meaningful - as sites of difference, filled with constructed meanings that are in need of constant decoding and interrogation. (DUCILLE, 1986). Ducille is not asking us to accept gender as a biological or metaphysical reality, but rather as an analytic tool that allows us to understand the complex relations between humans and humans, or in the case of the theme of this paper, humans and machines.

This would mean that designers and manufacturers of care robots will benefit from a clearer awareness of their own somatic reactions. As Shusterman points out,

> Much ethnic and racial hostility is not the product of logical thought but of deep prejudices that are somatically marked in terms of vague uncomfortable feelings and are thus engrained beneath the level of explicit consciousness. […] We often deny that we have such prejudices because we do not realize that we feel them, and the first step in controlling or expunging them is to develop the somatic awareness to recognize them in ourselves. (SHUSTERMAN 2013, n.p.)

Mass-marketing and reproducing stereotyped forms and visible signs of gender difference in care robots is an activity that has consequences for human beings. A critical engagement with these dynamics does not mean "piously praising and blaming others for their choices," but rather, as Taylor explains, "from the continual struggle to excavate, clarify, and domesticate the forces that condition our choices" (TAYLOR 2016, 129).

Conclusion

I began this paper by setting out two of the complexities that arise with humanoid robots and their design – (1) navigating the space between the "uncanny valley" and the persona effect; and (2) navigating the reproduction of gendered (and other) norms. My focus in this paper was on the second of these. I showed how the cultural realities of robotic scientists are embodied in the machines they design and manufacture, focusing specifically on the embodiment of gender. I argued for the value of a somaesthetic approach in order to avoid the normalisation of gender bias in gendered humanoid robot design. In order to escape the augmentation of historical misperceptions of women and men in machine bodies and so the entrenchment of sexism, a deep awareness of how robotic scientists tend to produce replicas of human bodies that are consistent with their own cultural norms in the form of a somaesthetics of robots is needed.

Relevant Literature

1. ALAČ, Morana, MOVELLAN, Javier and TANAKA, Fumihide. "When a robot is social: Spatial arrangements and multimodal semiotic engagement in the practice of social robotics", [Social Studies of Science], pp 893-926, December 2011. Vol 41. No 6.

2. BARTNECK, Christoph., n.d.n. "Robots and racism", [Proceedings of ACM/IEEE International Conference on Human-Robot-Interaction], pp196–204, 2018. IEEE: Chicago. doi: 10.1145/3171221.3171260
3. BENJAMIN, Ruha "Assessing Risk, Automating Racism," (2019) [Science], pp 421-422, 2019. Vol 366. Issue 6464.
4. BUOLAMWINI, Joy and GEBRU, Timnit. "Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification," [Proceedings of Machine Learning Research], pp 1-15, 2018. Vol 81.
5. ČAPEK, Karel, [Rossum's Universal Robots (R.U.R.), trans. Claudia NOVAK- JONES], 2004. Penguin Classics: New York. (Villiers de l'Isle Adam, *L'Ève Future*, trans. Robert Martin Adams as [Tomorrow's Eve]. 2000. University of Illinois Press: Chicago..
6. CYR, Dianne, HASSANEIN, Khaled, HEAD, Milena, and IVANOV, Alex, "The role of social presence in establishing loyalty in e-service environments", [Interacting with Computers], pp 43-56, 2007. Vol 19. No 1.
7. DINET, Jérôme, and VIVIAN, Robin, "Exploratory Investigation of Attitudes towards Assistive Robots For Future users" [Le Travail Humain], pp 105-126, April 2014, Vol. 77, No. 2.
8. DISALVO, Carl F, GEMPERLE, Francine, FORLIZZI, Jodi and KIESLER, Sara, "All robots are not equal: The design and perception of humanoid robot heads",[Conference on Designing Interactive Systems], 25–28 June, 2002, London.
9. DUCILLE, Ann. "Toy Theory, Black Barbie and the Deep Play of Difference.", [Skin Trade], 1996. Cambridge, MA: Harvard UP.
10. FEAGIN, Joe R. [The White Racial Frame: Centuries of Racial Framing and Counter-Framing], 2010. New York: Routledge.
11. FERRARI, Francesco, PALADINO, Maria Paola, and JETTEN, Jolanda. 2016. "Blurring human–machine distinctions: anthropomorphic appearance in social robots as a threat to human distinctiveness", [International Journal of Social Robotics], pp287-302, 2016, Vol 8, No 2.
12. GUEVARRA, Anna R. "Here Come the Robot Nurses" [Boston Review] AUGUST 2, 2021
13. HAMINGTON, Maurice. "Care Ethics and Engaging Intersectional Difference through the Body" [Critical Philosophy of Race], pp 79-100, 2015. Vol 3 No 1.
14. HAYASAKI, Erika. "Women vs. the Machine" [Foreign Policy], pp38-47, Jan/Feb 2017, No. 222, 2050
15. HELMREICH, Stefan, [Silicon Second Nature: Culturing Artificial Life in a Digital World]. 1998, Berkeley: University of California Press

16. HESS, David J. [Science and Technology in a Multicultural World: The Cultural Politics of Facts and Artefacts], 1995, New York: Columbia University Press.
17. HOCHBERG, Mark S. "The doctor's white coat: an historical perspective". [AMA Journal of Ethics], April 2007. Accessed September 11, 2020. https://journalofethics.ama-assn.org/article/doctors-white-coat-historicalperspective/2007-04
18. KELLER, Evelyn F. and LONGINO, Helen E. (eds.) [Feminism and Science], 1998, Oxford: Oxford University Press
19. LAMOLA, Malaselo J. "An Ontic-ontological Theory for Ethics of Designing Social Robots: A Case of Black African Women and Humanoids" [Ethics and Information Technology], pp 119-26, 2021, Vol 23, No 2 https://doi.org/10.1007/s10676-020-09529-z; http://hdl.handle.net/2263/80019]
20. LIN, P., ABNEY, K., & BECKEY, G. 2011. Robot ethics: Mapping the issues for a mechanized world. [Artificial Intelligence], pp 942-949, 2011, vol *175 no* 5.
21. MATURANA, H. R. & VARELA, F. J. [Autopoiesis and Cognition - The Realization of the Living], 1980, Dordrecht, The Netherlands: D. Reidel Publishing.
22. MATURANA, H. R. & VARELA, F. J. [The Tree of Knowledge - The Biological Roots of Human Understanding], 1987, *B*oston, MA: Shambhala.
23. MENG, Q. & LEE, M.H. 2006. "Design issues for assistive robotics for the elderly", [Advanced engineering informatics], pp 171-186, 2006, vol 20 No 2.
24. MOORE, Henrietta L. "Avatars and Robots: The Imaginary Present and the Socialities of the Inorganic" [The Cambridge Journal of Anthropology], pp 48-63, SPRING 2012, Vol. 30, No. 1.
25. MORI, Masahiro [The Buddha in the Robot: A Robot's Engineers Thoughts on Science and Religion]. 1999 [1981]Tokyo: Kosei Publishing Co.
26. NOBLE, Safiya Umoja, [Algorithms of oppression: how search engines reinforce racism]. 2018, New York: New York University Press
27. PARKS, Jennifer A. "Lifting the Burden of Women's Care Work: Should Robots Replace the "Human Touch"?" [Hypatia], pp. 100-120, WINTER 2010, Vol. 25, No. 1.
28. POITEVIEN, Jessica "This New Hotel Is The First In Africa To Introduce Robot Staff" 17 Mar 2021 https://www.travelandleisureindia.in/featured/africa-hotel-robot-staff/
29. RAMALEPE, Phumi, "Steve Biko Academic Hospital has a new robot helping out in ICU" [Business Insider SA], Jul 06, 2021.

30. RICHARDSON, Kathleen, "Disabling as Mimesis and Alterity: Making Humanoid Robots at the Massachusetts Institute of Technology" [Etnofoor] , pp. 75-90, 2010, Vol. 22, No. 1.
31. ROBERTSON, J. [Robo Sapiens Japanicus: Robots, gender, family, and the Japanese Nation], 2017, Oakland CA: University of California Press.
32. SHUSTERMAN, Richard, "Somaesthetics: A Disciplinary Proposal". [Journal of Aesthetics and Art Criticism], pp 299- 313, 1999, Vol 57 No 3.
33. ____. "Somaesthetics and Care of the Self: The Case of Foucault", [The Monist], pp 530-551, 2000, Vol 83, No 4.
34. ____. 2003. 'Somaesthetics and The Second Sex: A Pragmatist Reading of a Feminist Classic. [Hypatia] pp 106-136, 2003, Vol 18, No 4.
35. ____. [Body Consciousness: A Philosophy of Mindfulness and Somaesthetics], 2008, Cambridge: Cambridge University Press.
36. ____. "Somaesthetics" In: Soegaard, Mads and Dam, Rikke Friis (eds.) [The Encyclopedia of Human-Computer Interaction], 2nd Ed.. 2013, Aarhus, Denmark: The Interaction Design Foundation. Accessed 21 July 2021, https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/somaesthetics
37. SINGER, Peter W. [Wired for War: The Robotics Revolution and Conflict in the Twenty-first century], 2009, London: Penguin.
38. SULLINS, John P. "Robots, love, and sex: The ethics of building a love machine", [IEEE Transactions on Affective Computing], pp 398-409, 2012, vol 3, No 4.
39. TAYLOR, Paul C. [Black is Beautiful: A Philosophy of Black Aesthetics]. 2016, Malden, MA: Wiley-Blackwell.
40. UWIRINGIYIMANA, Clement. "Rwandan medical workers deploy robots to minimize coronavirus risk" [Reuters] MAY 30, 2020.
41. VENKATESH, Viswanath, and MORRIS, Michael G. "Why Don't Men Ever Stop to Ask For Directions? Gender, Social Influence, and Their Role in Technology Acceptance and Usage Behavior." [MIS Quarterly], pp 115-139, 2000, Vol 24, no 1.
42. ZIEMKE, Tom. & SHARKEY, Noel E. "A stroll through the worlds of robots and animals: Applying Jakob von Uexküll's theory of meaning to adaptive robots and artificial life", [Semiotica],pp 701-746, 2001, vol 134, no 1/4.