



Examining academic performance through ant towards rpa-based system in South Africa

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Abstract

Despite the numerous support systems, academic performances in many South African higher institutions continue to experience challenges while some are declining in throughputs. Some of the support mechanisms seem to be black boxed, notwithstanding the deteriorating situation. Thus, there is *prima facie* evidence that the factors that influence dwindling performance are unknown. This study, therefore, explores the effect of black boxing the support provided in the institutions, towards finding a long-lasting remedy to the challenges, through information technology (IT) solutions such as the robotic automated process (RPA). Qualitative data was used, to deeply understand why things happen in the way that they do in providing and receiving academic supports while performance remains low and challenging. The relationship and interaction between human and non-human actors of over ten years were traced in existing sixty-one documents and analysed. From the analysis, structural property, technological change, and power relationship manifest from the simplification of networks, durable configurations, and invisible factors. These factors were found to be of significant and dominant influence on academic performance through the support an institution provides. From the findings, a conceptual framework is proposed, purposely to guide an RPA-based system can be designed.

Keywords Actor-network theory · Black box · Academic performance · Academic support and structure · Robotic automated process

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1 Introduction and background

Simplistically, performance refers to a demonstration of skills, ideas, and knowledge, and understanding of concepts (Tuckman, 1975). Students' success and performance have impact on funding and employability (Yang & Li, 2020; York, Gibson & Rankin, 2015). On this basis, it is of paramount importance to effectively manage the academic performances of students, toward continuous improvement. However, the term performance is subjective; hence institutions of higher learning have desired standards and criteria as a yardstick for evaluation. From the assessment conducted by the Department of Higher Education and Training (DHET), academic performances in institutions of higher learning are declining. However, the challenges experienced with academic performance are not only in South Africa (Rodríguez-Hernández, Cascallara & Kyndt, 2020; D'Aquila, Wang & Mattia, 2019). Hence many studies have been conducted in this regard, in both developed countries (Crosnoe, Johnson & Elder, 2004; York, Gibson & Rankin, 2015) and developing countries (Asikhia, 2010; Mbiti, 2016; Dasuki & Quaye, 2016).

The academic performance of students in South African universities is steadily declining. In 2019, a report shows that only 39% and 56% complete their undergraduate studies in four (4) and six (6) years, respectively (BusinessTech, 2019). A year later, the statistic was confirmed to remain unchanged (Mutanga, 2020; Abed, Ajoodha, & Jadhav, 2020). Also, owing to the vast significance that is associated with the subject, studies have been conducted from different disciplines and professions such as sociology; applied sciences (Mehmood & Taswir, 2013); management sciences (Mushtaq & Khan, 2012); and psychiatry (Mekonen et al., 2017). The challenge of students' performances has come a long way. According to Mann (1985), the challenges with students' performances continue to persist and it is difficult to resolve. Even though students' academic performance remains a top priority for institutions of higher learning, the problem persists. Various studies have employed different variables in attempts to find solutions. Mehmood and Taswir (2013) explored the effect of social networks on students' academic performance. Crosnoe et al. (2004) examined the family factor but without the influences on the trajectories.

Many universities have employed various structures and mechanisms including the use of information technology (IT) solutions (such as software), to facilitate and enable supports for academic processes and activities, yet the problem persists. Currently, the Integrated Tertiary Software (ITS) system is used in most South African universities to capture students' demographic data, student accommodation, human resources, and financial information or fees (Mashabela & Pillay, 2017; Kiwana, Johansson & Carlsson, 2015). It is not an automation process and does not focus on assessing and managing students' academic performances. According to Chipeperakwa (2017), the ITS system is not an RPA based system but an Enterprise Resource Planning (ERP). The system does not have the capability and automation functionalities, to interact and produce the overall students' performance statistics per qualification (Tshitake, 2016).

The persistent nature of the challenge necessitates a fresh and alternative approach, such as a system based on the robotic automation process (RPA). RPA is a software that is robotic in its design and operation, to imitate human actions and automate rou-

tine or repetitive tasks (Zhang & Liu, 2019). Although RPA can enhance and improve academic performances, it has not been used in any South African universities (Job, 2019). The significant usefulness can be attributed to Pupkov (2016) explanation that an RPA system combines the interaction of humans with processes that work independently. Through these processes, decisions are made based on knowledge and information, to produce specific objectives. An RPA system can interpret data from different sources towards achieving an exact goal through flexible adaptation (Haenlein & Kaplan, 2019). In some universities, the systems are integrated with online learning software (Al-Tameemia & Xue, 2019) but not linked to the administrative systems used to capture students' academic performances. Despite the declining rate of academic performance, supports are stable and reliable in many institutions. Such stability is associated with black boxing from actor-network theory (ANT) perspective (Callon, 1986).

Given the critical roles of humans and processes in supporting academic performances toward a successful outcome, it is essential to investigate the factors that influence the supports, and how the factors manifest themselves, from the perspective of ANT, since other efforts have yielded little or no improvement. It assesses the conceptualization of black boxing technology, structure, and processing development that ANT offers, within which the factors of influence and their manifestations become the core of enquiry. The contributions of this study come from three main aspects. Firstly, it indorses the effect of technology change in the improvement of academic performance. Secondly, it reveals how stable South African institution of higher learning does not guarantee a success rate. Finally, it conceptualises a design in which RPA can be employed.

This paper is organised into eight main sections, sequentially. It began with an introduction, which outlines the focus and content of the paper. This is followed by a review of literature that focuses on academic performance in the South African context and an overview of ANT, the theory that underpins the study, respectively. In the fourth section, the methodology that is employed is discussed. The effects which black box have on academic support are presented and explained in the fifth section, and the findings are discussed in the section that follows. Next, the implications of practice are presented. Finally, a conclusion is drawn.

2 Literature review

Assessment of academic performance is often enabled and supported by IT solutions. Students' performances have been a serious challenge in many South African Higher education. Although many efforts have been invested, the challenge persist. This includes the creation different approaches (Erasmus & Fourie, 2018), new tutorial (Coetzee, Schmulian & Coetzee, 2018), development of support framework that can reduce attrition (Netandaa et al., 2019), and self-determinant approach (Naude et al. 2016). Many institutions continue in their efforts to address this challenge through various support means; however, it does not seem to be getting better, meaning performance and pass rates are not improving. This can be attributed to, either the influencing factors are unknown or how the factors manifest are not well understood.

There are various types of academic support for students that are created by different departments within many universities in South Africa. These support mechanisms are funded through internal and external sources and structures including government-funded scheme. In their study, Penn-Edwards and Donnison (2011) view academia as a place where students get support, purposely to complete their academic pursuits. Students' support includes services and activities required to develop academic skill. Many studies have focused on gaining understanding of how throughput rate can be improved in the universities (Onsongo, 2006; Paideya & Bengesai, 2017; Mudaly & Mtshali, 2018). In addition, the South African National Development Plan for 2030 formulated guidelines to increase participation and graduation rates (NDP, 2019). Despite these efforts, the challenge persists.

Factors influencing support have been argued to include lecture attendance, profiling students' background, programme evaluation, lack of access to support programmes (Onsongo, 2006; Paideya & Bengesai, 2017; Mudaly & Mtshali, 2018). Mudaly and Mtshali (2018) included personal factors such as financial and social supports as other influencing factors, in their study. Undoubtedly, institutions provide supports to students, which are often not measured. Performance is measured, among other things, to gain insights and improve the circumstances (York, Gibson & Rankin, 2015). Also, interaction with system, monitoring and management of processes are critical in attempts to improve the academic performance of students. These are some of the features, processes and activities of the RPA (Danilova, 2019).

Currently, South African universities employ IT solutions for processes and activities toward enabling and supporting students' academic performances. The HEMIS system is used in almost all South African HE institutions, to record and document students' that pass through the HE system (Cosser, 2018). The system uses the student's Identity number to track the historical information of students. ITS contains students' data and academic activities (Scholtz et al., 2018). Also, the system allows execution of other function such as online students' registration for academic session (Mashabela & Pillay, 2017), payment of fees, printing of class lists and assessment of marks including management of human resources' activities (Kiwana et al., 2015). The MAS tracks student marks (Tshitake, 2016). Students use the Student Online Service (SOS) system anytime to register, print registration information, change contact information, view their performance after term assessments and check and pay their fees online. HDC Digital is an administrative system used to monitor the progress of postgraduate students.

RPA is an example of how technology solutions have advanced, which influences the functionalities of organisations (Danilova, 2019). From Gartner's (2019) report, RPA is a productivity tool that allows users to configure scripts, to activate specific functions in an automated fashion. RPA-based systems involve the inclusion of new technologies, which include machine language, natural language processing, and the study of self-regulating systems (Kumar & Balaramachandran, 2018). Also, RPA operations include content migration which allows organisations to connect legacy systems to produce timeous reports (Madakam, Holmukhe & Jaiswa, 2019). With timeous and accurate information, academic departments can produce reports to make decisions regarding academic monitoring, measuring and managing performances. In addition, it can allow students to interact with structure and systems

with ease. Osman (2019) suggests that RPA interacts with other systems through the front-end and improves processes and decision support. However, these cannot happen, as has been the case, if the influencing factors are not known or how they manifest within an environment.

Based on the gaps that are identified from scrutinising literature as presented above, three fundamental questions are articulated: (1) What is the impact of simplification of networks on an academic institution? (2) What is the implication of durable configurations for academic structure and process? and (3) How does the invisible factors within academic environment influence structure and performance? Thus, this study explores the effect of black boxing the support provided in the institutions, towards finding a long-lasting remedy to the challenges, through IT solutions such as RPA.

3 Actor-network theory

The actor-network theory (ANT) is employed as a lens in the study. Primarily because the sociotechnical theory focuses on shifting and transforming an entity through negotiation and interpretation (Callon, 1986; Latour, 1996). Also, the theory addresses the elements of science and technology in a social system (Latour, 1987). The central tenets of ANT are actor, network, translations (Cresswell, Worth & Sheikh, 2010), which help to understand the trajectory of the challenges that influence academic performance from both teaching and learning including supports' mechanism perspectives. In ANT, actors are any entity that can make a difference in a network, which is both human and non-human (Iyamu, 2021; Callon, 1986). Actor-network consists of actors with allied interests (Modell et al., 2017). Iyamu (2018) explains how translation involves the association of networks and how the actors' interests align towards a common objective.

Primarily, ANT is concerned with how networks came into being, the traces of associations, how actors are enrolled, and how stability is achieved (Cresswell et al., 2010). Czarniaska (2014) explains that to understand the phenomena better, the researcher must shadow and follow the actors. By following the actor, an understanding is gained about how their actions and network became stable. According to Callon (1991), a network becomes black-boxed, meaning that its actions are known and predictable.

A black box consists of entities that together operate smoothly and are stable. Latour (2007) introduces the concept of black box in which he argues that science, technology, and society are inseparable. The entities remain integrated, for reasons of simplification and establishing durable configurations, purposely to enhance network stability (Law, 2009). It is in this context that Bussular, Burtet and Antonello (2019) argue that a black box is a legitimized practice that provides a stable platform for performing heterogeneous collectives. However, the factors that influence simplification and durable configurations are hardly known, as in the case of academic performance in South African universities.

The theory is considered relevant and valuable in analysing technology and development (Heeks & Stanforth, 2015). Primarily, this is because one of the strengths of

ANT is in its use “to analyse situations in which it is difficult to separate humans and non-humans, and in which the actors have varying forms and competencies” (Callon & Blackwell, 2007: 274).

4 Methodology

The document analysis technique is used to collect the data primarily because it helps to construct meanings associated with terms and interactions within a system. Bowen (2009) argues some of the advantages of employing document analysis are that existing materials stable and not obtrusive. According to Yin (2009), the technique provides exactness and broad coverage, which allow extensiveness. Furthermore, Iyamu, Nehemia-Maletzky and Shaanika (2016) propel the value and usefulness of existing materials as a technique that provides richness through balance and historical background and the span of time. In three main categories, education, RPA, and the theory (Black box) that underpins the study, five types of documents were gathered (1) peer-reviewed article; (2) Documentary evidence, (3) policy documents, (4) financial reports, and (5) strategic documents. Over 500 documents were gathered from different academic databases, which included Google scholar, EBSCO and AIS. The primary keywords and phrases used for searching are academic institutions in South Africa; robotic process automation in education; robotic process automation in institutions of higher learning; actor-network and black box; and actor-network black box in education. Preliminary analysis was conducted on the documents, based on which a total of 61 of the 500+ documents, as shown in Table 1, were considered most relevant and appropriate to the study.

The analysis was conducted using the hermeneutic approach, guided by black box, a component of ANT. The hermeneutics approach enriches IS philosophy, theory, research, and practice (Mutasa & Iyamu, 2021) by allowing and enabling repetitive reading, reviewing, and identification of critical and useful factors of significance to the phenomenon being studied. The approach focuses on the interpretation of language to gain a better understanding of theme, text and terminology. Understanding can be a process, therefore requires repetitiveness, which entails dialogue that

Table 1 Gathering materials

No.	Description of focus	No. of documents (2012–2022)
1.	Documents about South African institutions of higher learning, with specific focus on performances and challenges	27
2.	Documents that encapsulate the use of RPA as an IT solution in the areas of an education system.	12
3.	Articles relating to the use of Black Box to underpin studies in the field of IS.	22
Total		61

helps extract meaning from the texts or objects. Cole and Avison (2007) explain the viability of the hermeneutic circle in IS research, that it helps to reveal unexpected factors. Bologna, Trede and Patton (2020) argue that the approach guides subjective understanding of processes associated with actors' relationship and relational practices including unconscious structures and the influence of power in an environment.

The hermeneutic approach was primarily employed for three main reasons: (1) as a sensitizing approach to gradually gain a deeper understanding of the phenomenon, within context and perspective (Iivari, 2018); (2) for the purposes of interpretation of related texts, to make sense of the literature (Lee & Dennis, 2012) in alignment with the objective of this study; and (3) employing the approach is informed by the belief that there are hidden structures (black boxes), which requires subject interpretation.

The focuses were on actors' negotiation, interactions, relationships, and patterns of engagement, to uncover three main aspects: (a) how the existing groups came together to foster a common interest, either to receive or provide academic support or both; (b) the relationship that exists between the actors (students, academic and non-academic staff) in providing and receiving academic support; and (c) how available resource, such as IT solutions (software) are used to provide or receive academic support.

5 Findings and discussion

Analysis of performance's influencing factors such as curriculum, funding model, delivering of lectures for change involves opening the black box, which means problematisation of certain fundamental issues that hitherto were stable and may or may not have been identified as problems. From the analysis, three fundamental factors were found to influence performance and manifest to manipulate the activities of structures in academic institutions: (1) Simplification of the various networks, (2) Durability of configurations, and (3) uncovering of the Invisible factors. Table 2 is based on these: (a) a process of negotiation amongst the key actors (stakeholders) concerning their terms of engagement happens. The negotiations continue to shift

Table 2 Components of black box

Component	Description
Simplification of the networks	Uncovering activities and events that manifest into a black box. It is a process of understanding the governing rules and application of technology that leads to the simplification of actions (Valls Canudas et al., 2021).
Durable configurations	Durable configuration entails structural properties and enforcement of rules. It allows contents that are black boxed to be opened for reconstruction (Callon, 1986).
Invisible factors	A state, explicitly or implicitly, of object or subject that is not visible to the general public. It is invisible if nothing can be said about it (Latour, 2007).

until an acceptable compromise is reached; (b) durability propel change through its construction or deconstruction of stability, which, however, enable constructivism of emergence of new successful stability that is transparent; and (c) the hidden, unavailable or unexplained processes, circumstances and factors that lead to success or failure become visible for change attempts toward improving academic performances.

5.1 Simplification of the networks

In ANT, simplification is about making processes and activities of actor-network simpler. This makes heterogeneous actors perform at an optimum degree of certainty. It helps find answers to the complexities of black boxes that have made many institutions stagnant or regressive. Callon (1991) refers to simplification as *punctualization*. According to (Law, 1992:385), complexity is often punctualised (Law, 1992) but does not mean that items or activities are not lost in the process (Tatnall, 2003). This meaning helps us to understand that, literally, simplification of black boxes in the institutions can be viewed from two fundamental perspectives, firstly, it facilitates a deeper understanding of networks at different levels of complexity (Islam, Mäntymäki & Turunen, 2019); and secondly, it helps to dissect and gain insights to the granularity of structures and their focal points. These levels of understanding enable technological change that shapes processes towards flexibility and transparency, which engineer transformative agenda.

Simplification reduces the complexity that exists within actor-network and reflects in the actions and parameters that guide teaching and learning approaches (Valls Canudas, Golobardes Ribé & Vilasis-Cardona, 2021). Thus, the simplification of actor-networks can free the general academic stakeholders from the complex proprietary state of institutions' structures and interfaces, which ineffectively deliver improved academic performances.

By itself, simplification is not a goal. Engineering of transformative agenda enacts simplicity of standardisation, which streamlines administrative processes toward improving academic performances. Simplistically, by following the actors and their relationalities, it enables the development of a deeper understanding of an institution (Vickers, Moore & Vickers, 2018). Thus, simplification can improve orderliness demonstrating science in action (Langlitz, 2019), which Islam et al. (2019) amplify by arguing that it involves technology, to change processes.

5.2 Durable configurations

The academic system is configured into varieties of units (networks). Actors enrol in each of these units consisting of academic and non-academic (support) functions. In addition, there are heterogeneous employees and students within an institution. One of the goals of the university is for each unit to be stable. Stability can only be achieved if all actors remain faithful to the network. To ensure actors remain enrolled in the institution's objectives, the focal actors seek to 'black box' existing networks (Latour, 1987) by stabilizing activities through translation, which helps to close communication gaps and reduces controversies. At this point, the institutions make the cost of alternatives prohibitive, making it an obligatory passage point (OPP). The

OPP refers to the situation that must occur, for stakeholders to fulfil the interests that have been designed for them by the focal actor (Sage, Vitry & Dainty, 2020). OPP is enforced using policies of the institution. Thus, when an employee or learner's action is in contrast with that of the network, clauses in the policies are invoked, which often results in disciplinary actions.

A network becomes durable when actors do not feel the need to open and view inside of the black boxes but accept things as they are. In such a state of extreme stability (black boxed), employees (academic and non-academic) become increasingly delimited. Munro (1999: 433) refers to it as a translated state where some employees become functionaries or 'intermediaries without discretion' We do not live in a translated world, we translate the world, to enable negotiation. Learners accept lectures and contents of subjects (or courses). Educators accept the general rules as they are, whether it favours them and some of the learners, it doesn't matter. Hence the *modii operandi* of activities such as delivering lectures, funding mechanism, and availability (or non-availability) of resources are hardly questionable by the affected actors. Questionability invites interrogation and changes in the formation of alliances, which can cause the black boxes to be opened and their contents and approaches reconsidered (Callon, 1986).

When either the learners or education conflict with the OPP, their relationship with the authority is redefined. That does not necessarily mean that the black box will be opened, it only allows for demonstration of power, thereafter, stability is restored. Circumstantially, if no interrogation happens within lectures between learners and lecturers, the implication would be that the black box will not be opened, and support systems will not be reviewed so that the academic pass rate could increase.

5.3 The Invisible factors

Once actor-network is black boxed, there is hardly an escape route for the actor but to oblige to the passage-points. As a result, the factors that make up the black box remain invisible. The nature of invisibility deprives stakeholders of tracing both ontological and epistemological provisions of actors' making (Bajde, 2013; Latour, 1996).

The main problem is that institutions' structures are black boxed by virtue of their explicit decisions. Therefore, they encapsulate factors that are invisible and unavailable for interaction and negotiation. Consequently, these *prima facie* evidence contain the explanation for the success or failure of change attempts that could possibly improve academic performances. According to Latour (2007: 31), "There is something invisible that weighs on all of us that is more solid than steel and yet so incredibly labile". The boxes need to be opened to understand how those forces exist and why they exist in the way that they do (Iyamu, 2021), an alternative, which the RPA distinctively provides.

The properties of the factors need to be known, to understand the usefulness and how they are or can be used to support the translation of events in assessing academic performances. Therefore, it is essential to open the black box of technological solutions and processes to gain deeper insights into the actors and actions (Zawawi, 2018) in teaching and learning efforts.

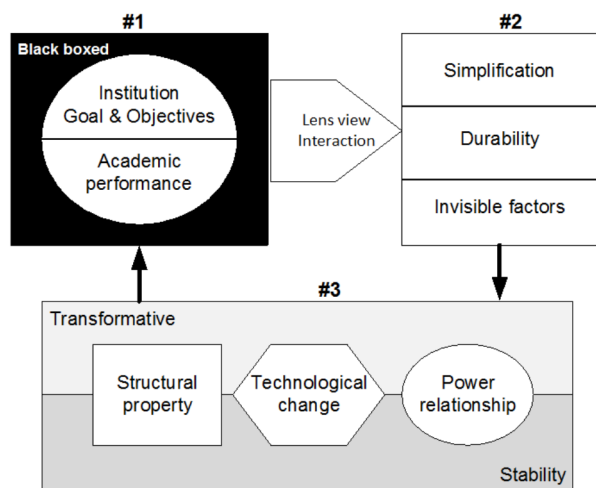
6 Design of interactive system

Based on the discussion of the findings presented above, an interactive system is designed, as depicted in Fig. 1. As revealed in empirical studies reviewed, course works are often black boxed, because learners and educators think of them as a single component of a curriculum. However, each course work is composed of various parts, such as different textbooks and assignments, and may reflect a variety of epistemological assumptions, which may or may not be explicit. For example, the affirmative rules that examinations are only a prerequisite for learners to advance to the next level of studies may be entirely uncontroversial for many human actors involved in the education ecosystem. However, this may be a thing of deconstruction for others, who solicit for oral and continual oral and written assessments.

A new approach is needed. Figure 1 depicts how systems or structures in an academic institution in South Africa can be depunctualised and redesigned, to imbibe simplification. The Figure is divided into three main units, black boxed environment; factors that manifest from the black boxes; and the factors that can influence the redesign of the actor-networks (structures within the environment). The goal and objectives of an institution are encapsulated within structures, intended to produce high performance. Consciously or unconsciously, the structures are black boxed. Through a lens, enhancement or alternative can be provided through technology and development, which ANT offers through its black box tenet according to Heeks and Stanforth (2015), this leads to the dynamism of technological change.

Conceptually, this is a design to reconfigure the actor-networks into black boxes, a state of stability. The conceptual design clarifies the need to have technological change that characterises flexibility, stability, and interoperability. RPA typifies these factors, which therefore must include the requirements that define and shape the development of an interactive system.

Fig. 1 Conceptual design of interactive system



6.1 Structural property

By opening the black box, it helps us to gain deeper insights into how sociotechnical artefacts are initially developed, modified, and applied to networks of alliances within academic institutions. This encompasses inclusiveness, which fosters understanding processes around implementing, embedding, integrating, and evaluating activities of education system, to improve academic performances. The inclusiveness can be facilitated by RPA, to transform operations and model academic interaction of critical importance, and to exploit augmented intelligence for better performance. Guacales-Gualavisi et al. (2021) empirically argued that RPA is increasingly being employed in the educational systems, to improve academic work.

The systems such as organisational structure and IT solutions can be constantly reopened and sealed because of their fluidity. However, this has not been the case in many institutions for many years. Hence, it is difficult, at least on an empirical basis, to identify the factors that persistently influence the low performance within academics. The current disposition finds its argumentative strength in, the longer a box remains closed, the more it is considered reliable and stable. “The more automatic and the blacker the box is, the more it has to be accompanied by people.” (Latour, 1987 p.137). Thus, we propose that the black box be opened, to identify the human and non-humans’ actors including their associations, to enable traces, holistic monitoring, and evaluation that is based on interaction, which foster transparency and better manageability. An interactive system that is more flexible and inclusive can be designed using an RPA-based solution.

6.2 Technological change

Technological change is central to development, and it entails innovation, including transferability, adaptability, and implementation (Heeks & Stanforth, 2015). The change involves a process or processes, which are driven by the different human actors. RPA offers a dynamism of technological change, which allows real-time processes and enacts human actors’ active participation in the events as they happen, while ANT offers traceability of the actors’ interaction and actions within the heterogeneous networks. In designing a system that has been depunctualised, RPA fits because it has tools to execute tasks that are of interactions between actors (Leno et al., 2021).

Despite the stability of academic institutions, the success rate is relatively not high. The study confirms that black boxing of technology or process does not guarantee desirable success. Technology plays a part in this stagnant. Technology that is used to enable and support academic processes and events need to change from its traditional to a more dynamic approach. RPA embroils dynamism, which facilitates speedy interactions between actors. It does not take away black boxing of the events. However, it allows flexibility in the opening of the black boxes. This allows the institutions to evolve with time in addressing the factors that continually influence academic performances.

6.3 Power relationship

There is a lack of dynamism, and the dominant power of some actors does not give ‘room’ to uncover the extent of academic causality, which contributes to struggling performances. Du Gay (1996) refers to not recognising that power relation as “congenitally failing operations”. Power relations between actors (students, academic and non-academic) can be better traced through an interactive system, which the RPA provides. Thus, a more explicit and implicit structural property can be better managed for the purposes of academic performance. Some institutions employ human-robot

Table 3 Implication of practice

Factor	Description of action	Involving actor
Transparency	Transparency invites more interrogations of events and actions. Subsequently, this will, on the one hand, strengthen processes and activities. On the other hand, it can unnecessarily delay process and progress. Hence advancement of manageability is critically required. Also, this helps to consciously and pragmatically open the black boxes rather than contrarily. In contrast, meaning blindly opening ‘black boxes’ can lead to a vortex of infinite regress as Harman (2009) puts it.	The roles of human actors (academic staff, support staff and students) without ambiguity, ease of translation. The non-human actors, such as processes, procedures require inclusiveness, and regular review, for ease of buy-in.
Inclusivity	As revealed, simplification is necessary, more importantly, it is progressive to create balance by periodically reopening the black boxes, to investigate the contents (Tatnall, 2003). This can ignite a more robust interaction between the involving actors, which can lead to more cohesion.	All actors in various networks, academic staff, non-academic staff, and students including the technology and processes that must be employed. An interactive system can be used to facilitate a relationship.
Convergence	Convergence allows existing actors to disengage from any of the networks (structures) and enrolment of new actors (Zawawi, 2018) seamlessly. This can be enabled by technology using RPA tools.	This entails transformative agenda, from a human and non-human perspective. The agenda must be well defined and transparent to all stakeholders.

interaction (HRI) to enhance teaching capabilities (Lasso-Rodríguez & Gil-Herrera, 2019), which removes the power relationship between academic staff and students.

This facilitates the interplay between RPA agents and students, for example, the interaction that happens between postgraduates and research units, where some students are often unhappy with response time or communication approach. Conscious and unconscious circumstances drive power relations, and sometimes, inherently fragile. From an organisational perspective, Knights and McCabe (2000) suggest that power precludes space for resistance because it is never exhaustive. From ANT and RPA terms, we live in a world that is of obligatory passage points and not an obligatory passaged point world. Power only exists to the extent that makes it possible for humans to resist. Thus, RPA provides translation of the activities and events, to enact OPP and ease resistance. Aguirre and Rodriguez (2017) argue that RPA automates rules-based interaction and processes that are routinised, to produce deterministic outcomes.

7 Implication of practice

In rethinking the current status quo, a rethink is needed, to enforce a new approach. From the subjective understanding of the impacts which the black box has on academic performance, as presented and discussed in Sects. 5 and 6, implications of practice are viewed from three angles, Transparency, Inclusivity and Convergence, as shown in Table 3. Each of the implications is described and involving actors are identified.

Explicitly, no one person or network can be responsible for the implications. Due to the essentiality of education, it is critical to continue to explore assessment models or avenues, for improvement purposes. From a different perspective, an understanding of the effect of the black box on academic performance is valuable to the involving actors. More importantly, the implications of the influencing factors as shown in Table 3. The implications pin both questions and criteria that per horizontal versus vertical to advance the science of measuring academic performance in higher institutions.

This helps in designing an RPA-based system and formulating or reviewing policies associated with teaching and learning. Based on the system and policies, a routine assessment can be conducted, to assist in revealing two fundamental things: (1) students' knowledgeability about available supports and processes; and (2) academic and non-academic staff influencing factors.

8 Conclusion

A black box is a stable and reliable functioning entity of entities (Callon, 1991), which opens the need to rethink and possibly shift from the current way of operationalisation. The functioning mechanisms remain completely unknown until it stops working (Couldry, 2008). Thus, if a university does not stop working, which is highly possible, its functioning mechanisms will not be known. Therefore, academic per-

formances are not likely to improve. Thus, it is critical to open the black box before designing a new solution. It is on this basis ANT was employed because the theory offers a powerful tool for opening the black boxes that exist in South African academic institutions, to intervene and provide a means for gaining deeper insights into the genesis of students' performances.

The use of ANT for analysis offers problematising freshness on how black box or boxes came to be in South African academic institutions through which some issue that hitherto was stable are depunctualised. This helps to reveal the influencing factors and sets investigative enquiring, to understand the roles of the different actors in academic performance, which has been a gap for many years. Also, it enables evident-based requirements that entail negotiation, for systems design that is inclusive in nature, which was thought to be missed by many actors in the South African academic sector.

The study can be used to guide the development and implementation of policies and other governance documents. Also, based on this study, institutions are highly likely to begin to understand the importance of transparent structures. Another significant aspect, the human actors can now begin to understand how they have unconsciously persistently nurtured relationships through their actions, which are enacted by the power bestowed on them by the institution's structure. This awareness is expected to bring some sanity between the academics and students, in sharing ideas and exploring challenges.

Finally, although this paper is not based on a case study, it is a strong foundation for case-based research. This is an area of research that should be of immediate focus for the benefit of the environment if significant contributions for improved academic performance are to be realised.

Declarations

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