



# AIOps in Higher Education Institutions

Thabo Sakasa and Tendani Mawela<sup>(✉)</sup> 

University of Pretoria, Hatfield, South Africa

u21249212@tuks.co.za, tendani.mawela@up.ac.za

**Abstract.** The study explored the opportunities, barriers and enablers for Artificial intelligence for IT operations (AIOps) in the higher education sector. It adopted the case study strategy supported by an interpretive and qualitative approach. Primary data was collected through semi-structured interviews with IT management and staff at two institutions of higher learning. The Technology Organisation Environment (TOE) framework was the theoretical lens used to understand the perceptions of the respondents regarding the barriers and enablers towards implementing AIOps. The results highlighted various themes related to the implementation of AIOps including: IT infrastructure, skills challenges, executive support, budget constraints, IT strategy and governance.

**Keywords:** Artificial Intelligence · Data Analytics · Machine Learning · IT Operations · Higher Education

## 1 Introduction and Background

Information Technology (IT) operations involves the activities of identifying, integrating and managing different products and processes to provide a stable, responsive and robust IT environment [1]. A healthy IT organisation provides a competitive advantage for organisations in a fast-paced market [2]. IT operations deal with the management of software and hardware, IT support, network administration, device management and their related functions in an organisation. Developments around artificial intelligence (AI) and big data analytics offer an opportunity for IT operations to improve how IT operations are managed. Artificial intelligence offers the opportunity to overcome IT operations challenges such as monitoring, alerts, redundancies, downtime and slow response [3]. Artificial intelligence for IT operations (AIOps) is a combination of big data and machine learning which optimises the related IT operations processes and tasks. The link between big data and AI has facilitated the development of AIOps. Big data and machine learning are central to AIOps to understand real-time insights into problems and incidents that affect the IT operations environment. Such insights are predictive and are accompanied by automated recommendations to address IT related problems.

IT underpins all of a higher education institution's principal activities. In many areas, IT contributes directly to the efficiency of the organisation's operations and in others, it is vital for the existence of the activity. IT has direct and indirect roles in supporting and enabling higher education institutions' vision and strategic objectives. The IT

function needs to be operated efficiently and effectively to enable the organisation to perform optimally. IT architectures are complex environments with many points of failures. Identifying these points of failures and resolving them on time presents a challenge to various organisations. Traditional IT operations, based on domain centric monitoring are unable to cope with the volumes of data produced that provide the required insight into the IT environment [4]. IT operations that are not optimally managed will negatively affect the performance of the organisation [5]. Scholars point out that the complexity of the IT environment requires a diverse set of skills [6]. In such circumstances, the IT operations team requires additional resources and approaches to manage the IT environment optimally to avoid downtime that can have negative consequences for the organisation. The impact and consequences of IT incidents that are not resolved can be severe. IT incidents can affect the adoption of useful technologies as shown by the reluctance of some faculties and lecturers [7, 8]. There is an opportunity for universities to consider implementing AIOps. The extant literature has limited studies focusing on AIOps and in particular in the higher education context. The study contributes to research about IT operations, big data, artificial intelligence and machine learning. This paper reports on a study that investigated the enablers and barriers to the implementation of AIOps in the higher education sector. The research question which underpinned the study was “*What are the barriers and enablers to the implementation of AIOps?*”.

## 2 Literature Overview

### 2.1 Artificial Intelligence for IT Operations

The authors in [6] refer to AIOps as, “a set of diagnostic and predictive tools, automation and humans-in-the-loop capabilities that will enable operation teams to embrace change”. AIOps is thus a combination of capabilities that guide IT operations teams in handling the challenges of complexity and high-performance demands that characterise IT operations, utilizing new and powerful technologies that provide the potential to transform IT operations. AIOps provides the ability to conduct real-time analysis of the entire IT operations environment, detecting and addressing issues and incidents at the same time. Artificial Intelligence for IT Operations is about the application of algorithms in IT operations. It is about the use of AI and machine learning to automate tasks and processes that are undertaken to plan and manage IT operations. AIOps can add value to IT Operations in the areas of: log analysis, capacity planning, infrastructure scaling and cost management. Also, with the wide acceptance and usage of cloud computing, the scale and complexity of services has increased, leading to challenges for the IT operations team, challenges that can be addressed by AIOps. AIOps may also be considered for server management, application support, and service desk management [9].

### 2.2 IT Operations Challenges

The challenges faced by IT operations are attributed to developments and innovations in IT. IT is becoming more complicated and sophisticated. It is highlighted by [6] that, “IT operations personnel spend a significant amount of time and energy trying to keep everything up and running and are always under mounting pressure to predict when things

will go wrong and be prepared with fixes and lengthy root cause analysis documents”. Some of the challenges for IT Operations include: scalability, shifting technology landscape, availability and reliability of technology, multiple and diverse platforms, tools and devices [1, 10–12]. Additionally, the IT environment contends with short release cycles, increasing negative and costly IT incidents [6, 13].

### 2.3 IT Operations in Higher Education

The focus areas for IT Operations in higher education, include student admissions, student data, learning systems, staff administration, payroll and financial accounting, inventory systems and library systems. A study on ICT investment in higher education [14] concluded that while quality and quantity were important factors, managers needed to prioritise the avoidance or elimination of downtime. IT is central to the effective provision of teaching and learning in higher education. It is against this background that IT operations are required to perform optimally for universities to achieve their objectives. Prior research [9] calls for a coordinated collaboration between institutions of higher learning and the software engineering industry.

### 2.4 Enablers and Barriers for AIOps

The following barriers towards innovations such as AIOps are highlighted in the literature: Uncertainty in organisations on whether AIOps is a hype or a true innovation, since it is a major shift from traditional IT operations [4]. Due to the transformative nature of AIOps to IT operations, which requires realignment of people, processes and technology, it may discourage organisations to commit to AIOps [2, 15]. The IT architecture required for AIOps in terms of hardware and software may require large investments [16, 17]. Also, a lack of skilled personnel may inhibit the successful implementation of AIOps [15]. A lack of understanding of big data and low confidence in managing big data is a potential barrier to AIOps [18, 19].

The following outlines the enablers that may support a move towards AIOps as noted in the literature: Cloud computing and Network and Data Center Operations with AI can support the implementation of AIOps [6, 9]. Additionally, coordinated collaboration between institutions of higher learning and the software engineering industry [9, 11]. The ability to correlate millions of data, analysis of the data, determination of patterns and presentation of data in meaningful formats is an essential part of driving AIOps [4, 18]. Trends indicate that training in AIOps related fields by companies and some tertiary institutions is also supporting upskilling towards AIOps initiatives [20].

## 3 Theoretical Framework

The study investigated AIOps and the barriers and enablers that affect its implementation in the higher education sector and relied on the technology-organisation-environment (TOE) framework as a theoretical lens. The TOE framework [21] takes the approach that an organisation’s ability to adopt technological innovation is affected by three elements, which are technology, organisation and environment. This framework was used as a

basis of understanding the barriers and enablers of the implementation of AIOps as well as the analysis of the data that was collected. The framework points to a convergence of organisational factors supported by technological factors and the macro environmental context leading to a better opportunity for the successful adoption of innovations like AIOps. The TOE framework as articulated by [21] and [22] was useful for understanding how organisations may consider AIOps as well as the barriers and enablers towards adopting it. Research indicates that the TOE framework is capable of being applied broadly and has the potential to explain a number of technological, industrial and national or cultural contexts about the enablers and barriers that affect innovations such as AIOps [23, 24].

## 4 Research Method

### 4.1 Overview

The research study adopted the interpretive philosophical paradigm. The exploratory and qualitative study aimed to explore and illuminate the barriers and enablers to the implementation of AIOps in the higher education setting which has limited research studies. The research adopted a case study strategy [25] and included respondents from IT operations teams of universities. The research was based on two organisations in the higher education sector. The case study organisations are herewith referred to as Organisation A and Organisation B. Organisation A is a traditional university which offers mainly contact learning and a few distance learning classes while Organisation B is technical university offering mainly distance learning classes and some contact learning. Organisation A has 39 953 students enrolled across undergraduate and postgraduate degree programs. It has staff complement of 5818 including academic, administrative and management staff. The IT department of Organisation A has 110 staff members. Organisation B has 65 920 students enrolled with a total staff complement of 3199. The IT department of Organisation B has 115 members of staff.

### 4.2 Population and Sampling

Purposeful sampling [26] was applied to identify professionals who are working in the IT operations environment at higher education institutions. The choice of this population was based on the understanding that they would be knowledgeable and best placed to be able to answer the research questions pertaining to the implementation of AIOps. A total of 18 participants across the two organisations participated in the interviews. 56% of respondents were male and 44% female. 61% were in operational roles in IT while the balance held supervisory, management or strategic positions.

### 4.3 Data Collection and Analysis

An interview guide aligned to the TOE framework was compiled and ethics clearance obtained for the research study. Semi-structured individual interviews were conducted with the members of the IT operations teams at both institutions. All interviewees signed

consent forms and the interviews were recorded. The recordings were transcribed. We relied on the thematic analysis approach as recommended by [27] to analyze the data. The TOE framework informed the coding and interpretation of the data.

## 5 Findings and Discussion

### 5.1 Technology

The technology theme deals with the IT architecture, infrastructure, automated diagnostic and predictive tools, automated mechanism of tracking, monitoring and resolving incidents, automated correlation between the infrastructure and applications teams as well as the analysis of logs. As highlighted by [4] current IT architectures are organised in silos, which presents a challenge for the IT operations team. With these silos, the IT operations team is unable to combine, analyze and correlate data from the different domains to provide insights that the IT operation's teams require to manage the environment proactively.

#### IT Architecture and Infrastructure

With regards to the IT architecture and infrastructure of Organisation B's readiness for AIOps, the Microsoft Enterprise Specialist said he *"cannot see that happening"*, while the Deputy Director ICT Infrastructure said, *"currently we are not ready for that, but we are working towards that"*. At Organisation A, the ICT Support Manager said, *"I'd say yes. I do think that the systems we have now are able to integrate with artificial intelligence and the latest technologies. The reason why I am saying so is at the moment from an audio-visual perspective, we have implemented a smart class room...It's a device whereby it can tell you that a certain device has gone down. You know, and obviously that pulls in from other systems. So, we already have that type of integration to put Artificial Intelligence on top of it obviously if possible... So yes, I do believe we have, we can do that. There is that capability"*.

This is an interesting remark considering that the readiness of an IT architecture to implement AIOps is a complex endeavor and incorporates more than one tool or audio-visual integration. However, it is noted that the remark does acknowledge the significance of integration of solutions in order to build a foundation for AIOps. The IT operations environment at Organisation B is generally at an entry level with regards to the implementation of AIOps. The IT architecture and infrastructure is not ready for AI, data analytics, big data and machine learning. A few of the participants expressed that they were unsure of the readiness of their organisation to implement AIOps. At Organisation A, the IT architecture / infrastructure was described as capable of integrating AI, machine learning and data analytics, especially from an audio-visual perspective. Another participant confirmed the same position and added that further investment would be required. From the data it appears this university is partially ready. According to Organisation's A annual report, the infrastructure and new technologies required to support the new digital strategy have been implemented, the infrastructure has been improved, classroom technologies have been upgraded as well as laboratories and the training of the academic staff. This indicates a plan being implemented for a solid foundation once the implementation of AIOps is considered. The overall feedback though is that the IT

infrastructure is not fully ready for AIOps implementation, which points to this aspect as being a barrier. It reflects the silo approach, which [4] indicated as the reason for IT operations teams being unable to correlate data from different domains to provide the required insights. The authors in [28] emphasise the need for infrastructure and operations leaders to prioritise architecture if they want to succeed in transforming the service desk to incorporate machine learning, big data and other AI technologies. They argue that those who do not take this approach will become increasingly irrelevant. Authors [6] also purport that an AIOps IT infrastructure should break the silo-based tools and integrate data related to events, metrics, logs, job data, tickets and monitoring.

### **Automated Diagnostic Tools**

When asked about automated diagnostic tools a participant highlighted that: *“So, in the IT ops environment at the moment, I’m reluctant to say there is none. We have just installed or implemented the core Advanced Technology Systems Laboratory (ATSL). Therefore, our service desk is equipped. In addition, obviously the tool is new but we would like to use the tool in a way whereby we could start automating ... so it is early days. But the tool is able to do so.”* - ICT Support Manager, Organisation A.

This finding is consistent with literature in terms of the location of diagnostic tools at the service desk. Such a location enables the tools to interact with the service desk agents. The study by [29] concludes that 40% of all large companies will combine data and machine learning functions to replace the service desk partially. According to [28], the service desk needs to be transformed into a proactive function through AI. The authors in [20] reported on a service desk that was equipped with diagnostic tools, which enabled it to learn from previous logged problems, and the applicable solutions to provide. Capacity planning illustrates the significance of diagnostic tools when it comes to AIOps. Currently it is indicated that IT operations teams perform capacity planning manually. They rely on existing specifications and analyze performance related shortcomings based on these specifications. This becomes an ineffective approach for large institutional environments such as Organisations A and B, characterised by large, complex, multi-tier applications and different service providers. Without diagnostic tools, the IT operations team is estimating the number of CPU cores required, the amount of RAM storage required and the network bandwidth required.

On the automated diagnostic tools, the situation from both Organisation A and B is generally not optimal. There were a few silo tools, for example in the network environment. There are no predictive tools used across their IT operations. As highlighted by [6] AIOps includes, *“a set of diagnostic and predictive tools, automation and humans-in-the-loop capabilities that will enable operation teams to embrace change”*. Organisation A and B may need to consider the implementation of automated diagnostic tools as a foundation for the implementation of AIOps. There is a change required for the successful implementation of the diagnostic tools. The IT operations teams need could implement a change management process to revisit some of their past approaches and may consider the potential of AIOps.

### **Tracking and Monitoring**

*“The only thing that we use is a manual system. That is how we track every movement*

*but we don't have something that is predictive.*" - Learning Technologist, Organisation A.

From the data collected, there was not much implemented with regards to tracking and monitoring. There are elementary disparate tools utilised, for example, at Organisation B, the network team has a particular application for Wi-Fi monitoring. According to [2], distributed environments are characterised by different applications running on different platforms, which presents a challenge for tracking problems, resulting in downtime, which affects organisations negatively. The organisations interviewed in this study face this challenge. AI offers the opportunity to overcome IT operations challenges relating to monitoring, alerts, redundancies, downtimes and slow response [3]. An interesting aspect is that the interviews at Organisation A were delayed due to a downtime incident that affected the entire institution. There were teams running around trying to diagnose and fix the problem. There was pressure on the IT operations team since there were assessments also scheduled for that morning. It became apparent that tracking and monitoring was not at the required levels as it took some time to resolve the incident. The literature indicates that, where tracking and monitoring is not optimal, there will be endless downtimes and wastage of resources, which will eventually frustrate the end users. [8] stated that some faculties and lecturers in the higher education environment have expressed reluctance in adopting online learning management systems due to the impact of IT performance. In a complex environment with numerous points of failures and many access points the authors in [6] advise that organisations need an automated way of tracking, monitoring and resolving issues before they result in downtime.

### **Correlation**

*"Yes. Yes. There is, there is. A little bit. Yes, we need some improvement. You see there is a process especially on applications that is managed by us. But because there are now many other pieces managed by another company. So, we rely on one another. But on our applications, there is a process which we should upgrade."* - Deputy Director: ICT Infrastructure Organisation B.

Correlation in the AIOps environment is the collection of data from different sources (servers, network, operating systems, databases, etc.) and consolidating this data to determine relationships between infrastructure and applications [4]. There is an indication of a lack of understanding of the type of correlation required for the implementation of AIOps from the participants that were interviewed. Correlation between the infrastructure and applications teams is deemed to be at a basic level. Instead of the notion of correlation, the participants referred to teamwork. Correlation requires an improvement in both organisations. According to [7] correlation is critical. It is an interesting observation that the concept of correlation from both institutions seems to be very low in both understanding and execution. Since the environments are complex at both institutions, it would be expected that correlation would be central in the IT operations management approach. As outlined by [4] correlation covers the data about the application performance, events logs, transactions and more, including the network and storage resources dealing with the delivery of the application. Without this information, the IT operations team is operating with insufficient information and has limited understanding of what is

happening with the applications. These may have a negative impact on the ability of IT operations to deliver a good service.

### **Log Analysis**

*“It’s all manual it’s not automated. But I believe all the new products will have an application like that and then we will start with some of that.”* - Information Security Specialist, Organisation B.

The analysis of logs from an IT operations team’s perspective is linked to data analysis. Where there is no culture of analysing data, there will be very little analysis of logs for the purposes of managing the environment optimally. Research [3] maintains that log analysis is the obvious place to introduce AI. Literature points out that every component of the IT operations e.g.: hardware, software, operating system, servers, applications and databases generate logs that can be analyzed by machine learning algorithms. This can assist the IT operations in identifying problems proactively. Log analysis at both organisations was found to be at an elementary stage. They indicated plans to improve however it was not applicable in all the IT operations areas. Log analysis focuses on the proactive analysis and visualisation of the data generated by the logs for problem identification. The IT operations teams rely on these logs in order to gain an understanding of the performance and health status of the different IT components. This process often requires significant human intervention, with the teams analyzing these logs and determining the root cause of the problem or potential problem as well as determining the intervention approach. AIOps introduces machine-learning algorithms, which can proactively find problems and potential problems before they happen [19].

## **5.2 Organisation**

This section discusses the organisational theme. From the data, the organisational aspect consists of management support for AIOps, skills set of the IT operations team, the awareness levels of the team, the utilization of data analytics and the budget allocation for IT operations. “The ability to adopt AIOps depends not only on the availability of monitoring data and automation systems, but also the alignment of people and processes” [2].

### **Management Support**

*“I think management actually care and that they want to go in a certain direction on IT. But I think they do have a clear plan on how to get there. So, I think I’ve got a feeling that support is there in principle, but we don’t have a plan that is in place. You know the plan is to be co-created between management and operations.”* - Research Computing, Organisation A.

IT operations, is essentially a management function that is driven by various processes to ensure availability and performance of IT systems. For such a function to succeed, the support of management is required. IT operations play a crucial and supportive role in organisations. A healthy IT function provides key competitive advantages for organisations in a fast-paced market [2]. Management support incorporates the allocation of the required resources, human and financial as well as ensuring that stakeholders cooperate to achieve efficient IT operations. In some cases, management is



also required to undergo changes and training to understand and support the implementation of AIOps. Management support at both educational institutions was perceived as being generally positive by the respondents. There is room for improvement, as it was highlighted that sometimes management does not understand some of the IT concepts. Management support is often a prerequisite to the successful implementation of strategic projects such as AIOps. There is evidence that Organisation A's management is supportive of the development of the infrastructure and new technologies required to support the digital strategy, which will enable better IT support, access to broadband and faster Wi-Fi connections, the development of smart classrooms, simulation laboratories and the training of academics to participate in the digital era. They did note some challenges regarding the network related to the upgrade project, which has taken longer to complete along with performance issues. These challenges are being addressed by the organisation. Respondents indicated that an internal oversight and management committee was established to address the challenges, and to ensure that the project remains on track until it is completed. This was noted as an enabler towards implementing AIOps.

### **IT Skills**

*“We have no knowledge of that. Not there yet right now, there are no data analysts in the environment. The IT environment people who deal with the analyzing data are not really qualified for that. I think that is one of the reasons we are speaking of this. We can always do with more than what we are getting from the government, in terms of funding. We do the best we can. But we are not there yet.”* -Microsoft Enterprise Specialist, Organisation B.

The skills required for AIOps are not at the required level at both institutions. Both organisations report that there is a need for up skilling. AIOps skills represent an enhancement of the current IT operations teams' skills set. Such skills will evolve over time to include knowledge of machine learning, programming and security. It is argued by [17] that the skills required for digital transformation should be developed within the organisation to enable the growth of a digital mind set. The issue of data scientist or data analysts is an interesting one. Participants from both institutions acknowledge the importance of such skills in the IT operations environment. However, both organisations reported that they have no data analysts. The IT operations team needs training and education in AIOps and big data analysis. There will be a need to consider involving data scientists to augment the team with the necessary big data skills. The literature highlights that the lack of appropriate skills is one of the reasons that organisations are not utilizing big data to their advantage [16]. The overall analysis of the AIOps, big data and machine learning skills of the IT teams at both institutions is that they do not exist. The skills aspect of the two institutions thus represents a barrier to the implementation of AIOps.

### **IT Operations' Team Awareness**

*“Yeah, so, there is the awareness and I think it is based on us coming to the strategy session years ago. When we sat down, we said where we are going to. Where is the world now and how do we get there? And we sat down we considered and know what things are coming up....So, we are definitely aware and we keep on you know researching. You know and always look at the technology curve. Just to see what is coming up so we can*

*plan and be ready for what's coming up next. So, we are definitely with it.*"- ICT Support Manager, Organisation A.

On the IT operations team's awareness, both institutions recorded positive feedback. Literature emphasises that there are no easy steps to implement AIOps [6]. There is a need for the IT operations team to keep up with developments, focus on supporting the business and also transform as a team as well. It has been indicated that a high level of awareness creates a receptive climate for change [12]. The authors argue that in organisations where there is overall lack of awareness and understanding of the value of big data and AIOps, the staff will see little value in executing these initiatives. The implementation of AIOps would require a receptive environment as well as a strong change management programme. Although both institutions recorded positive results on awareness, there is an indication that there is some way to go before these teams can be confirmed as being aware of the holistic transformation they need to undertake to implement the requirements of AIOps.

### **Budget**

*"...And the money that is required we are still saying, can we have that? And the answer is always: there is no budget...And it is more even last year if I'm not mistaken. We had a couple of posts that we were looking for. I don't even think we got the money with budget cuts."*- Senior Manager Business Solutions, Organisation A.

University budgets are under pressure due to a variety of factors such as an increase in the number of students enrolling for higher education, declining grants and the fast developments in technology. In such circumstances, IT operations may be considered a lower priority when it comes to budget allocations for projects such as implementing AIOps. Universities may be satisfied with maintaining the status quo when it comes to IT operations and not necessarily willing to allocate budget towards innovations such as AIOps in the context of budget constraints. However, this may affect IT operations negatively in the future. The budget is generally viewed as inadequate for a move towards AIOps. There is a strong view that the budget partially addresses what is required for a university in the digital transformation era. Thus, budgetary constraints are deemed as a barrier towards AIOps.

## **5.3 Environment**

This theme covers the policy provisions that govern the university's IT operations, the IT strategy as well as governance. Students at universities are exposed to the technological developments of the digital transformation era, which includes mobility and exposure to a variety of applications. They tend to be more proactive and demanding of IT resources such as bandwidth, availability and support. It is against this background that universities have to formulate policies that meet the student and staff demands in a manner that is cost effective while not hindering developments and advancements. Universities require appropriate policies to manage risks, and should review these policies regularly to ensure compliance.

### **Policies**

*"They exist, but then I've forgotten the terms that was used then but essentially, it needs to*

*be said that they exist but they need constant updates. They need to be a living document but it needs to be relevant to the university's circumstances. Relevant to big data, machine learning. We have a very strong digitization drive.*" - Senior Manager Business Solutions (ERP), Organisation A.

Organisation A reports that the information security and the cyber security policies that were approved in the last two years have been implemented. It further reports that the university council has paid more attention to the revision of policies, with a focus on IT and compliance with a view to improve the governance framework. This has been reflected from the data collected from the participants. What is perhaps missing is an understanding that organizations may also need technological tools in order to implement policies successfully, especially in a large and complex environment. It is one thing to have a revised policy and another to have a successfully implemented policy. The institutions have a gap in as far as the tools that are required for a successful implementation of IT policies. From the data, the policy element at both institutions is overall positive due to the existence of an applicable policy framework.

### **Strategy**

*"We definitely use them to build that team... So, one of the things I think we try to stay better ahead in that sort of focus point. If I look at it some of the universities have the resources. It's a question of how do you utilise them."* - Information Security Specialist, Organisation B.

The IT strategy is also an important indicator of the university's readiness or willingness to undertake the implementation of AIOps. AI has the potential to assist organisations, however, it is complex and requires the development of a comprehensive strategy in order to realise its benefits. Literature [20] pointed out that there is a need for organisations to take incremental steps with the currently available technology while planning for transformational change in the not-too-distant future. This reflects the importance of considering AIOps as part of the strategy for the provision of IT services. The feedback on the IT strategy was positive for both institutions. There was an acknowledgment of its existence, in some interviews partially, in some cases hundred percent with the digital drive being prominent. Organisation B reported that the Office of CIO and Executive Director has delivered on The Digital Transformation Strategy, which aims to unify technology plans through a redesigned enterprise architecture framework, and redeveloped business processes to support a digitized environment. This is an indication of IT strategic objectives being supported at Executive level, which is a positive development.

### **Governance**

*"I think it is very good in governance... With good governance you get happy customers."* - Research Computing, Organisation A.

Governance deals with the planning arrangements that ensure IT resources and services meet the needs of the students and staff in an efficient and economic manner, while complying with legal and regulatory requirements. To implement governance, universities investigate best practice models and frameworks for IT, especially those that are adopted by higher education institutions [30]. As universities have many unique characteristics, governance normally reflects such characteristics at particular times. There is no one model that fits all universities. Feedback from participants reflected a good

position for governance from both institutions. There is an indication of having IT governance, and planning as well as defined governance structures. In some cases, governance is viewed as delaying decision making but necessary. At Organisation A, a new operational model which involves the conclusion of service level agreements (SLA's) between IT and various other units within the institution has been established with the objective of managing IT's performance in this regard. Several structures were created to manage risk, security, compliance and efficiencies around the use of ICT infrastructure. This is another enabler towards an environment that may exploit AIOps.

## **6 Conclusion**

### **6.1 Recommendations**

It is suggested that to move towards AIOps and the benefits it promises, management and IT operations practitioners consider planning for the replacement of the traditional domain-based IT architectures with the consolidated unified architectures that include cloud computing, virtualization and agile development. Such a plan should be accompanied by the required diagnostic predictive tools, tracking and monitoring as well as how the correlation of data will be achieved. It is recommended that management and IT practitioners consider implementing effective and optimal log analysis as a foundation for the implementation of AIOps. Also, it is suggested that management and IT operations teams establish a project to raise awareness on AIOps across the organisation. There is a need to allocate a sustainable budget to prepare for the implementation of AIOps that will include training, workshops, tools and pilot initiatives for AIOps. Senior management, the Executive, the academics and students should be made aware of the potential value and benefits that AIOps will provide to the teaching and learning processes. It is recommended that management and IT practitioners should also establish formal initiatives to understand, manage and leverage on the data that is being generated from the IT operations environment as a preparation for the implementation of AIOps. Furthermore, it is recommended that higher education management and IT operations practitioners consider collaborating with the IT industry to develop an understanding of the context, trends and tools that relate to AIOps for higher education institutions. Management may consider implementing a pilot project that will automate the enforcement and execution of policies as a precursor to the implementation of AIOps.

### **6.2 Contribution and Concluding Remarks**

The study contributes to the literature on the subject of AIOps which authors such as [9, 11] and [29] have highlighted is required. Additionally, research on AIOps in the higher education sector is limited. The study highlighted the challenges, complexity and effort required to implement AIOps in higher education. This study brings forth the perspectives of IT operations practitioners on the barriers and enablers affecting the implementation of AIOps in institutions of higher learning. From a theoretical stance the study is an example of how the TOE framework may inform the understanding of the complex issues surrounding the adoption and implementation of AIOps in higher education. On a practical level, the study offered several recommendations that IT management

and executives may consider when implementing AIOps. This study was limited to two institutions of higher learning. Future studies should consider conducting a study at multiple organisations across a variety of sectors. This would assist in better understanding the dynamics surrounding the adoption and implementation of AIOps. Future research should involve defining the baseline technological readiness for AIOps and how this could assist organisations in transitioning from the traditional IT operations models.

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