Evaluating the Efficiency of a Procurement Process at An Institution of Higher Learning

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Abstract

The higher education sector spends a large percentage of the total revenue receipts on purchases of goods and services annually. It also faces multiple challenges with regards to its supply chain processes, such as deficiencies in implementation of internal controls relating to supply chain management and procurement. Other challenges include ancient systems and technology inefficiencies. These inefficiencies in procurement processes affect major research activities by having long lead times for research equipment. The aim of the study is to evaluate the efficiency of a procurement process for research equipment by conducting a survey among the users of this process. A survey was conducted at the using a sample of 108 participants from institution's faculties. It was found that there were various issues and inefficiencies in the procurement process and ERP System such team responsiveness, order accuracy, time taken to prepare and approve requisition and asset registration time. The paper ends with propositions for improvement techniques to be utilized for further study and continuous improvement.

Keywords
supply chain efficiency, procurement, purchase order, ERP system

Introduction
The higher education sector experiences multiple challenges with regards to its supply chain processes and they include lack of standardized processes and procedures, which in turn impacts efficiency (PWC 2015). A report by KPMG South Africa (2016) , stated that some of the challenges faced by the higher education sector include the poor implementation of standard supply chain management practices, inefficiencies in supply chain processes, poor planning for procurement and the lack of skills and capacity. At an institutional level, the Durban University of Technology (2018) noted that, institutionally, there were deficiencies in implementation of internal controls relating to supply chain management and procurement. Other challenges include lack of performance monitoring and management systems, as well as lack of adherence to the principles of demand and acquisition management within the broader university (PWC 2015). The lack of performance monitoring is as a result of departments instructing the buyer to use their preferred supplier because it is the only supplier who gives that particular service, and this affects in proper monitoring of supplier performance (KPMG 2016). The other causes of the challenges in the front of performance monitoring include the emergency orders that can encourage irregular expenditure.

These challenges are further affirmed by Dlamini (2016), in a study to determine the challenges faced by comprehensive universities in South Africa hindering the implementation of best practices. These challenges include manual systems delays and technology inefficiency, unethical conduct, capacity & shortage of skilled staff.
The inefficiencies in university supply chains such as procurement processes are affecting major research activities by having long lead times for research equipment, software and other enabling tools (Reynecke et al. 2018). Supply chain processes are the heartbeat of organizations as they ensure productive and proficient service provision. For any sector, efficient business processes are critical and imperative. On the organizational level, for the realization of business targets, a special attention to supply chain is essential, as this is the hub of the company activity. In order to

remain competitive, the higher education sector needs to continuously improve its supply chain processes, as they are key to optimal performance.

Buys (2018) reviewed the South African government's plans to increase student enrolment in the higher education sector to approximately 1.62 million by 2030. These plans will result in an increase in expenditure levels, procurement of research laboratory equipment, everyday consumables, and software and journal subscriptions will have to be managed efficiently. This means that procurement of resources via supply chain management (SCM) processes will become progressively crucial in ensuring that higher education institutions (HEIs) achieve these ambitious targets. The common audit findings of PWC (2015), show that the South African higher education industry had unique issues such as document management, supplier database management, contract management as well as supplier management and development. The report further states that most universities do not have a procurement plan, and in some universities it took 2,5 years to get the procurement policy through Senate and Council (PWC 2015). At the Department of Higher Education and Training (DHET) level, one of the causes of the lack of standardized processes is that universities are not obliged to comply with the requirements of the Public Finance Management Act .

For this study, the procurement process for research related equipment and services was selected. This is because research in a university is a big part of the reasons for existence and relevance. This is affirmed by Taylor (2018), who stated that within the Universities, research has taken a new significance and relations with business were established using the exploitation of research findings. Taylor (2018) further recognizes that there is an increase within governments and institutions to utilize and recognize significance of research for economic competitiveness. For this reason, there is a compelling need to invest in research and this requires universities to spend on research related equipment. The survey was used to investigate process inefficiencies experienced by researchers, staff and students when using the procurement process. The findings of the study will be used in developing model solutions that an institution of similar nature can assimilate in their environments.

1.1. Aim Of the Study

The main aim of this study is to investigate the current supply chain process efficiency at an institution of higher learning and propose solutions that advance productivity grounded on lean management and digitization. The results may be compared to the overall supply chain management efficiency within the higher education sector. The research questions are:

- What are the current practices and efficiencies in the procurement process for research equipment at this institution of higher learning?
- What are the solutions from lean management and Industry 4.0 that can be recommended to improve supply chain efficiency for the procurement process?

1.2. Background of the institution where the study was done

The HEI that the study was done is a part of South Africa's 26 public universities. These universities are part of DHET. The DHET also encompasses the Technical and Vocational Education and Training (TVET), which is responsible for dealing with TVET Colleges.
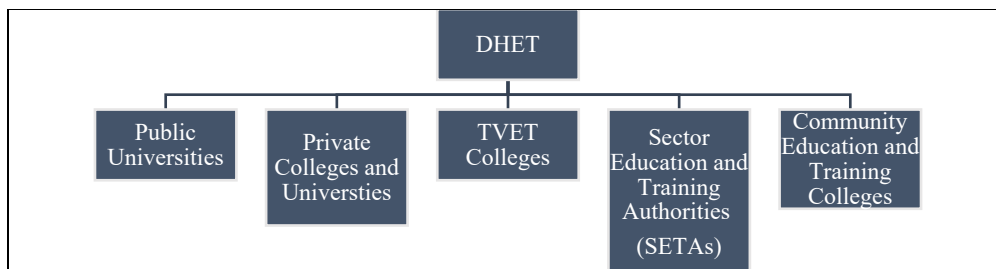

Figure 1. Overall Structure of Higher Education Institutions in South Africa

The institution is also part of the Universities South Africa (USAf), which is an umbrella organisation comprising of 26 public universities distributed in all nine provinces in South Africa. The Vice-Chancellors or principals of all the member universities, who act as accounting officers of their respective universities, constitute the Board of Directors for this body (Ambe and Badenhorst-Weiss 2012). The Board leads and contribute to Strategy Groups which give

effect to Universities South Africa's strategic framework by shaping, conceptualising and directing the implementation of projects and programmes.

1.2.1. Organizational Structure

The organogram for the institution is critical in identifying responsibilities and roles within an organisation. This is acknowledged by DeCanio et al. [19] by stating that the organisational organogram impacts general behaviour of employees, value chain, units and subunits within the organisation. For this study, it is important to understand the organogram as to identify the roles of levels of management in the requisition approval architecture. This clearly identifies the approval and delegation authority impacting on the procurement process for research equipment. The Executive Management Committee is responsible for the management of the institution and has the approval authority. This is an abridged organogram to highlight the procurement approval hierarchy.
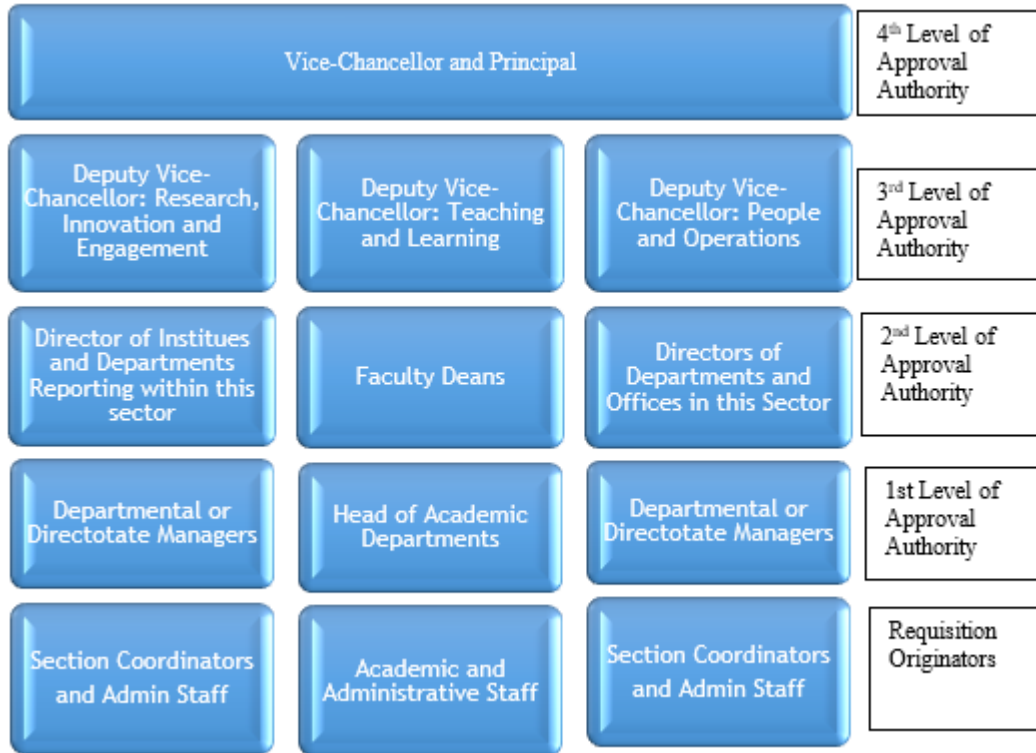

Figure 2. Organogram and delegation authority

2. Literature Review

2.1. Importance of Procurement

The role of procurement in an organization is beyond the regular belief that procurement's primary role is to procure items in response to organizational needs (North Carolina State University 2011). It supports operational requirements by understanding business requirements, quantifying and fulfilling them (North Carolina State University 2011). This is further affirmed by Ramírez and García (2006), by reaching the conclusion that procurement is an important part of supply chain that goes beyond fulfilment of materials by impacting other supply chain functions and business objectives. When fulfilling the demand for these products and services, the important considerations are right source, price, quantity, specification and more importantly, the right time for use. As described by the OECD, (2019), public procurement is one of the major economic activities in the world and accounts for12% of GDP for OECD member states, thus making it a key economic activity. High standards of ethics and efficient procurement are supreme for management of large government revenues, therefore both private and public institutions dealing with procurement activities need efficient collaboration.

2.2. Procurement within the Supply Chain Architecture

It is important to determine the location of procurement in the entire supply chain. This is critical in identifying role players and responsibilities for efficient achievement of business objectives. Prasetyanti and Simatupang (2015) suggested that a supply chain consists of activities and facilities performed to fulfil customers' requests. The role players involved include manufacturers, suppliers, transporters, warehouses, retailers, and customers. They further suggest that the recent focus on supply chains is value creation and value constellation for the customers. An example of a supply chain would comprise of demand and supply planning, procurement, inbound transportation, warehousing, outbound transportation, customer services and customer collaborative planning (Mohaiminul 2017). From the analyses of the two of Prasetyanti and Simatupang (2015) and Mohaiminul (2017), a typical supply chain in an organization has a set of activities directly linked by upstream and downstream flows of products, services, finances and information that collaboratively pull what is needed to meet the needs of an individual customer.

Downstream and upstream flows in a supply chain are differentiated by the direction of entry or exit in the organization (MTEC 2017). The upstream flows are characterized by the inward flow of materials into the organization and downstream characterized by the finished goods outward the company to the end-users.
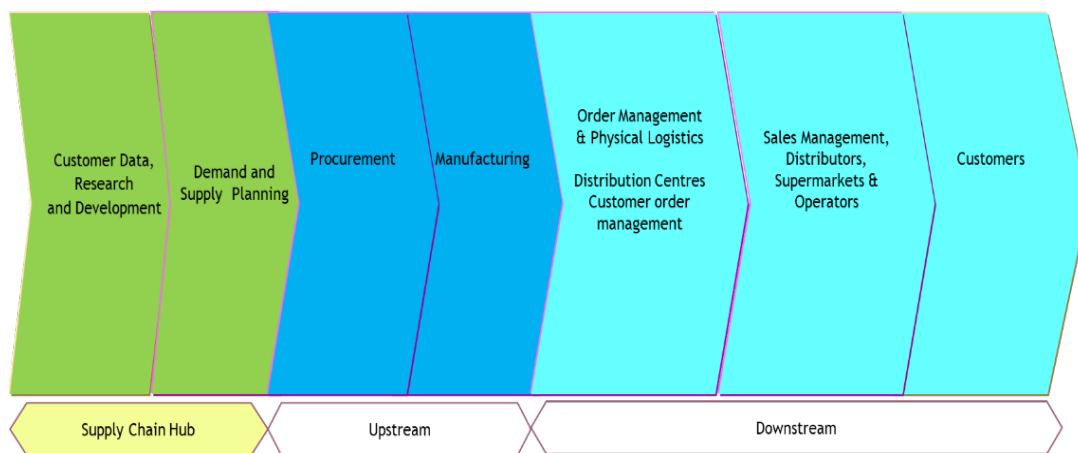

Figure 3. Supply Chain Streams

2.3. ERP Systems and their complexities

An Enterprise Resource Planning (ERP) system is an integrated business management system covering functional areas of an enterprise like logistics, production, finance, accounting and human resources (Babaei, Gholami, and Altafi 2015). This demands that an organization must have a robust yet versatile ERP system to ensure that the supply chain is functional and effective. According to the CIPS (2019), institutions have transformed the use of their ERP systems and procurement systems in order to achieve versatility. A big challenge in the implementation of ERP systems is complexity. It is a significant factor to the adoption of ERP and organizations interested in a simple solution rather that the complex interface as they want to focus on profitability and growth (Ruivo et al. 2013). The other challenges include high costs of implementation, risk of investment, choosing the right enterprise system, integrating with external companies and many others.

2.4. Inefficient Procurement Processes

Inefficient procurement processes can be detrimental to business objectives. In their study, Magadzire et al (2017), observed a number of undesirable results of inefficient supply chains in the medical field. These include delays in awarding of pharmaceutical contracts, and high levels of medicine stock outs. In the South African context, Ambe and Badenhorst-Weiss (2012) stated that public procurement faced enormous difficulties such as knowledge and skills, non-conformance, fraud, corruption and unethical behavior. Among other suggestions, OECD (2016) promotes the principles to deal with unethical issues around procurement such as transparency and e-procurement.

2.5. SCM Landscape in government and higher education institutions

The DHET(2021), noted that there were inefficient internal supply chain management processes which contributed to a number of procurement delays. This shows that there are challenges at the governmental level of higher education. Although universities are not expected to comply fully with the PFMA, they are required to comply fully with accounting standards, and each university has its own policy on supply chain management (Parliamentary Monitoring Group 2020). The challenge of not having standardized processes across the universities may emanates from that, unlike TVET colleges, they are not obliged use the requirements of the Public Finance Management Act. This allows universities to develop their own standard procurement processes with may be inefficient, thus creating a comparison point between universities. In contrast, this may not be a bad practice as it allows each university to develop processes that are defined by the procurement landscape and challenges specific to each operating environment. Within the South African context, some university councils have decided to adopt the principles of the act, as it results in effective management of finance and supply chain management.

3. Methods

This research was conducted through a questionnaire in order to assess the perceptions of procurement process efficiency when buying research related equipment and services. The survey was sent to researchers and collected online. The online survey enabled the continuation of the research considering the existence of the COVID-19 pandemic, which made a face-to-face interaction challenging.

Furthermore, the survey had low costs in terms of administering and was quick in gathering the desired information. It consisted of 28 questions related to efficiency of the procurement process for research related items. The compiled questions were comprised of a combination of those requiring a participant to choose only one answer per question. The questions were presented cogently to reduce confusion for participants through the survey. Majority of the questions were choice based, meaning that they did not need to type answers for most of the questions. The questions were developed based on the envisaged key performance indicators that are important and sensitive to end users as well as general supply chain efficiency indicators.

The critical questions were on team responsiveness, accuracy, order processing speed and ERP system effectiveness. There were other important questions related to the delegation authority by management. The target population for this research was the administrative staff, 2nd year doctoral students and postdoctoral researchers in the university. They were chosen because they conduct research and are involved in purchasing equipment for research execution of their research. The omission of fulltime academics and researchers is justified because they belong to departments and utilize the administrative staff for their procurement needs. Meaning that, their omission does not play a big role in the results, as their purchase requisitions are initiated and processed by the departmental administrative staff. Table 1 presents a record of the participants in the study.

Table 1. Sample size at the institution/university

Faculty	Total Participants Per Faculty
Accounting & Informatics	17
Applied Sciences	39
Arts & Design	6
Engineering & Built Environment	19
Health Sciences	9
Management Sciences	15
Research Innovation and Engagement	3
Total	108

A pilot study was conducted by sending the questionnaires to a selected group of thirty-two researchers, administrative staff (departmental secretaries) and students across all the faculties, who answered the questions and confirmed that the questions were relevant and applicable to their needs when procuring research related equipment. The online survey was then then sent to the population of departmental administrative staff, second year doctoral students as well as postdoctoral researchers via email. The online survey enabled the continuation of the research considering the existence of the COVID-19 pandemic, which made a face-to-face interaction challenging. The questions included

"yes/no" questions, rate on scale and fixed answer options. The questions were categorized into two categories. The category A questions are related to perception to efficiency. They are:

- acquaintance with the procurement team
- team responsiveness and order accuracy,
- requisition preparation and approval time
- ERP system efficiency
- supplier payment delays

Category B questions are related to time and efficiency. They are:

- time taken to prepare requisition,
- time taken to enter the requisition the system after approval
- product/service processing time by supplier
- Asset registration time

The bias related to demographics in this research was avoided, as the participants were not chosen based on gender, age or race but only on the basis of falling within the research pool (had potential to buy related research equipment & services). All ethical considerations were also taken into account and abided by, according to the institutions ethics and gatekeeper approval. The researcher saw the need to pre-test the survey as a way to ensure its efficiency in gathering data. The researcher first moved to forward the survey questionnaires to a selected group of 32 researchers, staff and students across all the faculties, who answered the questions and confirmed that the questions were relevant and applicable to their needs when procuring research related equipment via their emails to retrieve the answers they had forwarded after 24 hours. This enabled the researcher to identify the shortfalls the questionnaires possessed and made corrective measures, especially the questions that proved to be unclear or vague.

The second pre-test was with individuals with the same characteristics as the research population. Individuals with knowledge of lean management, industry 4.0 and supply chain were identified and after asking for their consent, the questionnaires were then sent to their emails. This further enabled the researcher to see the shortfalls in the wording of the questions. Thus, some questions were further rephrased, some deleted altogether, and others replaced as a way to gather relevant and rich data regarding the subject matter. The questions were also categorized so as not to confuse the future respondents to the survey questionnaire. The final survey pre-test was done with two of the individuals in the actual research study. The researcher did this to ascertain the level of sensitivity the questions may bring to the research under study. This also was the final test to have a clear picture of what to expect from the sample population and their level of understanding to the made simple wording of the questions. Asking for feedback from the participants after the pre-testing and getting a positive response that the wording and approach were understandable became the final draft that was forwarded to all the other research participants.

4. Results and Findings

The results from each question were tabulated for analysis. The data from the questions relating to similar characteristics was combined for simplification, e.g., requisition preparation time and approval time. Below are the findings from the participants utilizing the standard procurement process of this higher education institution.

4.1. Acquaintance with the procurement team

The results from the survey show that 45% of the respondents had knowledge of the procurement team and structure, 16% were not sure of the structure. According to Mikalef et al (Mikalef et al. 2013), procurement has a large role in yielding positive supply chain management performance. Thirty-nine percent of respondents did not know the procurement team structure and contact persons purchase order tracking and other queries. It is therefore critical to develop solutions around this area as to ensure that the critical key performance areas of the team are easily accessed and improved.

4.2. Team responsiveness and order accuracy

Figure 4 below indicates that 25.9% of the respondents perceived the procurement team as always responsive. The results show that for mostly responsive, rarely responsive and sometimes responsive options, the percentages were 25.9, 20.4 and 27.8% respectively. The combined 41.1% of the respondents perceived the procurement team to be sometimes and rarely responsive, thus not very confident of the responsiveness of the team. As this question was

enquiring the perception the respondents had on responsiveness to queries and communication by the procurement team, it is critical there are improvements in this area.
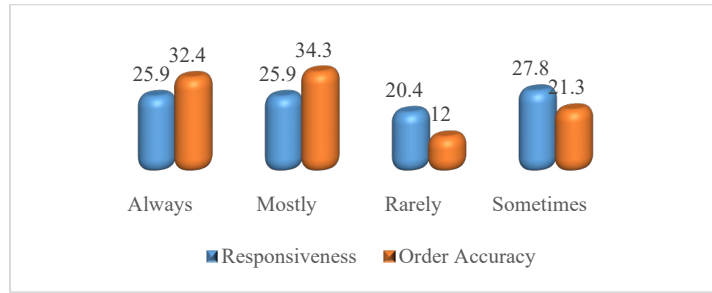

Figure 4. Results on team responsiveness and order accuracy (percentages)

The results also indicate that 32.4% of the respondents observed the procurement team as always accurate. The results show that for mostly, rarely and sometimes accurate options, the percentages were 34.3, 12 and 22.3 % respectively. The combined 33.3% of the respondents perceived the procurement team to be sometimes and rarely accurate, thus not very confident of the accuracy of the team. This question was enquiring on order accuracy of the requisitions. An accurate order is critical in ensuring that the right research equipment is delivered.

4.3. Satisfaction with requisition approval and processing time
Figure 5 indicates that 85 respondents were satisfied with the time taken to approve the requisition by management. The other 23 were dissatisfied. The similar results were for the satisfaction on requisition processing time. Most of the respondents were satisfied with the processing times, but the dissatisfied group was an indicator that there must be interventions.
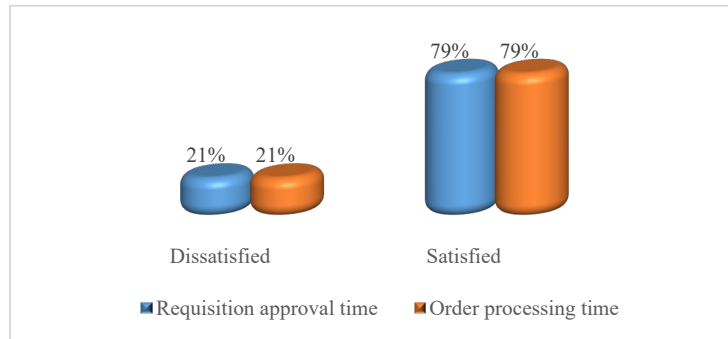

Figure 5. Results for satisfaction with requisition approval and processing time

4.4. Perception on ERP system efficiency
Of the 108 participants, 21% were dissatisfied with the efficiency of the ERP System. A large percentage of 79% was satisfied. Even in this kind of positive result, there is always an opportunity for improving further.

Table 2. Results for Satisfaction with Order Processing System used

Satisfaction with Order Processing System	
Dissatisfied	Satisfied
21%	79%

4.5. Perception on supplier payment delays
The results indicate that 26 (24%) of the respondents experienced supplier payment delays while 82 (76%) did not. Supplier payment delays is 24%. This is a noteworthy point to develop solutions around.

4.6. Requisition preparation time & approval time

Table 3 indicates that 38 (44.5%) of the respondents took less than 3 hours to prepare the requisition. For, 3-8 hours, 8-24 hours,1-2days and more than 2 days options, the frequency and percentage were 15 (13.9%), 4 (3.7%) , 38 (35.2%) and 13(12.%) respectively. For the requisition approval time, it is noted that 20.4% of the respondents had their requisitions approved between 1 and 2 days. Any delay in requisition approval will have an impact the procurement process.

Table 3. Results for requisition preparation time & approval time

		Less than 1 hour	Between 1 and 3 hours	3 - 8 hours	8 -24 hours	1-2 days	More than 2 days
Requisition preparation	Frequency	10	28	15	4	38	13
	%	9.3	25.9	13.9	3.7	35.2	12.0
Requisition approval by management	Frequency	16	19	7	12	22	32
	%	14.8	17.6	6.5	11.1	20.4	29.6

4.7. Order Entry time on the system after approval

This question was asked to ascertain the time taken to enter the order in the system after approval by procurement team. This is the conversion of a requisition to a purchase order. It includes the budget control process

Table 4. Results for the time taken to enter the order in the system after approval

	Time delay for order release by procurement team	
	Frequency	Percent
Between 0 and 3 hours	7	6.5
3 - 8 hours	12	11.1
8 -24 hours	27	25.0
1-2 days	20	18.5
2-7 days	13	12.0
More than 7 days	29	26.9

Table 4 indicates that 7 (6.5%) of the respondents had their requisitions converted to purchase orders between 0 and 3 hours. For 3-8 hours, 8-24 hours, 1-2 days, 2-7 days and more than 7 days options, the frequency and percentage were 12 (11.1%), 27 (25%), 20 (18.5 %), 13 (12%) and 29 (26.9%) respectively. The significant share of 61.1% of respondents had their requisitions converted to purchase orders in between 0 and 2 days. For the rest of the respondents, this was more than 2 days. From the raw data of the survey, the nature of these items or services bought was complex and high value (as per the delegation authority), thus explaining the delays while waiting specification confirmations.

4.8. Product/service processing time by supplier

Figure 6 indicates that 14 (33%) of the respondents had their items manufactured or service made ready by the supplier between 0-2 days. For 2-7 days ,1-2 weeks, 3-6 weeks, 7-10 weeks, 11-20 weeks and more than 20 weeks options, the frequency and percentage were 25 (23%), 23(21%) , 9(8%) , 5(5%) and 3(3%) respectively. 63% of the respondents had their items manufactured between in less than 2 weeks.
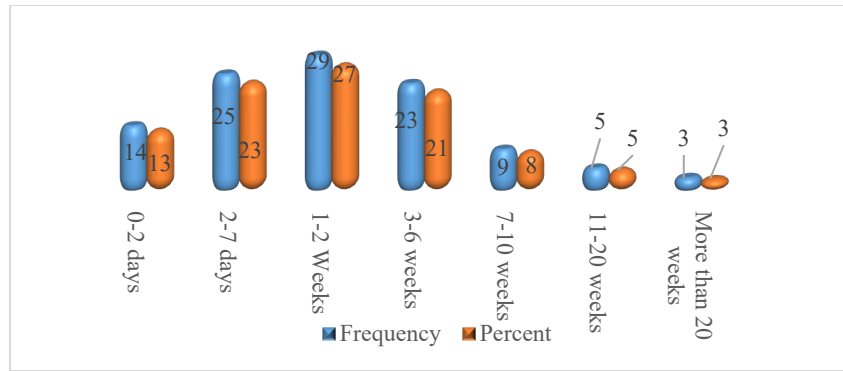
Figure 6. Time taken for release order release to the supplier

For twenty-three percent of the respondents, the supplier produced their items between three and six weeks. For the rest of the respondents, this was more than 11 weeks. From the raw data of the survey, there were delays in supplier payment and due to the nature and high value of items, some were delayed in the tender committee process.

4.9. Asset registration and installation time

Table 5 indicates that 32 (29.6%) of the respondents had their items registered on the asset register between 0 and 1 day. For 2 to 7 days, 1-2 weeks, 3-5 weeks, and more than 5 weeks options, the percentages were 29.6, 22.2, 13 and 5.6 respectively. 59.2% of the respondents had their items registered on the asset registry in 1 week. It took between one and two weeks for items to be registered for 22.2% of the respondents. For the rest of the respondents, this was more than 2 weeks. One of the problems observed is that for the equipment purchased during the COVID19 pandemic, the items took longer to be registered on the asset register. This was mainly due to remote working schedules for the researchers, students and staff. When the Assets department physically visited the offices for tagging, the equipment custodians were either working at home or not available to open offices.

Table 5. Results for time taken to register item on the asset register

		0 to 1 days	2-7 days	1-2 weeks	3-5 weeks	More than 5 weeks
Asset registration time	Frequency	32	32	24	14	6
	%	29.6	29.6	22.2	13.0	5.6

5. Discussion

In their study, Masete and Mafini (2018) found that inconsistent business processes, long lead times, inefficient processing of SCM-related transactions were prevalent in a HEI in the Limpopo Province of South Africa. Furthermore, the study revealed that these issues were ineffective and hampering the efforts of the institution to fulfil its mandates. The results emanating from the current research study, such as the dissatisfaction with the approval times, supplier payment delays and procurement team responsiveness, reveal that these problems identified by occur in other HEIs. Although the public universities are not obligated to follow the Public Finance Management Act, they still have links to cooperative governance prescripts and are largely influence by South African government acts such as Preferential Procurement Policy Framework Act and Section 239 of the Constitution of South Africa (Dlamini and Ambe 2012). This means that the universities must align their procurement practices to support the government goals. Such practice may assist in aligning the processes have some uniformity across the higher education landscape, enabling knowledge sharing on processes, thus improving supply chain efficiency.

From the study results, it is visible that there are process inefficiencies, starting from requisition generation, through to approval, supplier payment and asset registration. These delays have an effect on the availability on the research equipment, and they affect the research output of researchers and students that depend on experiments to be conducted on this equipment. For the postgraduate students, they will need to extend their study time and thus affecting the throughput and graduation rates for doctoral students. From a supplier point of view, their finances are impacted by

supplier delays. Since the SCM department is the hub of activities of the institution, it is important that they gain confidence from the internal and external stakeholders. Metrics such as order accuracy, lead time, order delivery time and asset registration time, are not only important to track, but be improved constantly.

One of the main points of convergence for the higher education sector's SCM, is through the Purchasing Consortium Southern Africa (PURCO). PURCO SA is a non-profit body created that incorporates most South African and Namibian higher education institutions (PURCO 2021). This institution assists the HEIs to manage tenders, negotiate better contracts, reduce their costs and improve their effectiveness (PURCO 2021). According to the PURCO, (2021), the 26 universities spent R1,3 billion, between 2020 and 2021, via the contracts negotiated by this institution. This convergence can bridge the gap between the varying institutional processes, thus allowing benchmarking of best practices throughout the higher education sector. The inefficiencies identified in the study can be improved by benchmarking the best operational procedures from other institutions. However, the institutional landscape, processes and culture varies from institution to institution, thereby necessitating the tailored recommendations and solutions. It is for this reason that there are internal recommendations for this study.

6. Recommendations

From the results of the survey, it is clear that there are major gaps in the processes ranging from the satisfaction with requisition and approval time. In order to do the recommendations, a qualitative review of literature was done to identify the solutions that can be implemented to improve the efficiency of the process. From this review, the DMAIC methodology will be used. In their study, Farsi et al. (2020) validates an optimization framework for improving service supply chain performance using DMAIC cycle. Their study used a bespoke service provider was used to test the applicability of the framework. The framework is clear and concise and will be utilised in the implementation steps. Another study by Monteiro et al. (2017), lean office tools were used to analyse logistics processes to clearly identify roles and tasks of each employee. Using a technique called Action-Research, Susman and Evered (1978), the study achieved its objectives by reducing wastage and achieving transparency.
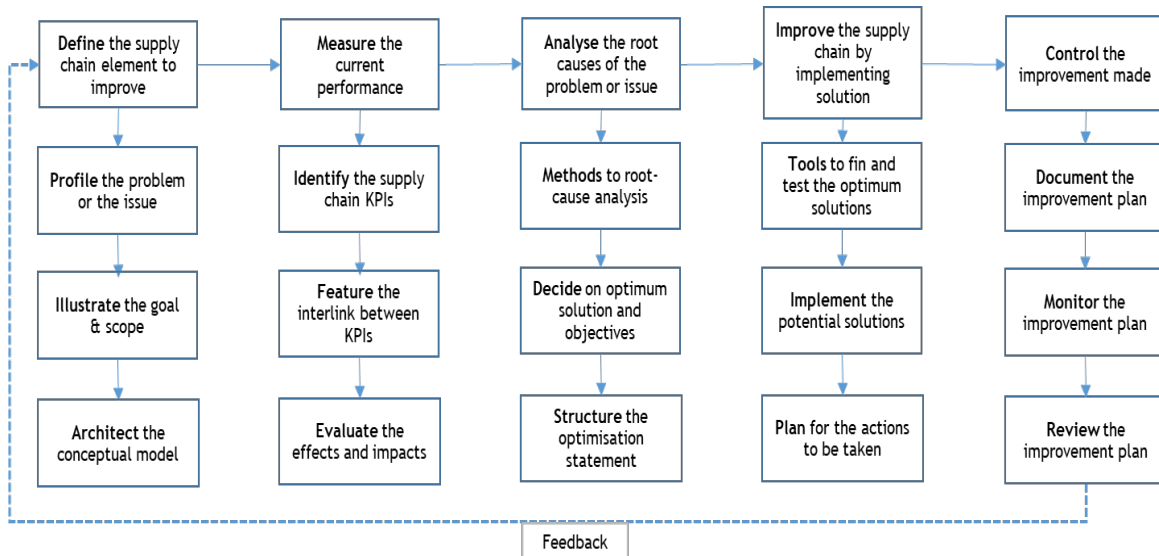

Figure 7. Optimisation framework for supply chain performance improvement

Source: Farsi et al (2020)

From these studies, a list of issues and project to be implemented for improving efficiency as listed in Table 6.

Table 6. Summary of interventions to be implemented for improvements

No	Recommendation	Problem being addressed	No	Recommendation	Problem being addressed
1	Visibility Flowchart with procurement Steps, Process Diagram, responsible persons and their contact Information	The procurement team and their responsibilities are not known by 39 % of the respondents	2	Implementation of key performance indicator tracking + DMAIC methodology to eliminate inefficiencies of the requisition conversion process	To reduce the time taken to convert the requisition into purchase order.
3	Using Augmented Reality and Virtual Reality Applications for visualisation of research equipment and correct specifications before manufacturing	The combined 33.3% of the respondents perceived the procurement team to be sometimes and rarely accurate	4	DMAIC process to identify the inefficiencies, and improve the time taken to release the purchase order to the supplier plus digitized workflow management for the notification of unreleased purchase orders	To reduce the time taken to release the purchase order to the supplier
No	Recommendation	Problem being addressed	No	Recommendation	Problem being addressed
5	Digitized workflow management for the delegation authority for requisition approval	a significant 21% were dissatisfied with the time taken to approve the requisition by management	6	Usage of Big Data applications to collect and digitise data from previous invoice, contracts, delivery times, lead times, supplier locations and its climate. can disrupt the supply chain system	To assist with improving time taken to manufacture research equipment
7	Implementation of key performance indicator tracking. (Time between capturing of the approved requisition system to when there it is converted to a purchase order)	21% dissatisfaction rate with the time taken to convert the purchase requisition to purchase order.	8	The use of Value Stream Mapping (VSM) can be used to eliminate the inefficiencies in the supplier payments.	Inefficiencies in the supplier payment process
9	Robotics Process Automation for automatically filling the fields of the digital requisition form and online bidding	Delayed procurement from manual requisitions being lost	10	DMAIC and value stream mapping exercise, the gaps and inefficiencies in the transportation will be identified and defined. Intermodal transportation can be utilised as well	Inefficiencies in time taken to deliver the equipment
11	DMAIC for to analyse and eliminate all inefficiencies in the process requisition preparation time.	Significant 50,9 % took more than eight hours to prepare requisition.	12	the utilisation of smart tags with RFID by the asset management department for tracking and can be integrated with app-based tracking	Inefficiencies in the asset registration and management of research equipment

13	DMAIC methodology to improve time taken to approve the requisitions + Digitized workflow management for the delegation authority for requisition approval	To reduce the requisition approval time	14	The use of Augmented Reality and Virtual Reality may be implemented as to assist the technicians during the research equipment assembly and installation	Inefficiencies in the research equipment assembly and installation process

6. Conclusion

In this study, the survey was done to ascertain inefficiencies in the procurement process of research equipment in an institution of higher learning. The extent of inefficiencies was categorized into two categories of satisfaction and time taken to complete task in the procurement process. Various issues were such as that the respondents didn't not know the procurement team structure for purchase order tracking. Other issues were around time taken to prepare and approve the requisitions. Asset registration time was also an issue that was exacerbated by the COVID-19 pandemic. It is therefore critical to develop solutions around this area as to ensure that the critical key performance areas of the team are easily accessed and improved. Continuous improvement techniques such as DMAIC and Lean Office tools are used to recommend potential solutions for issues identified in the study. The recommendations also touch on the use of 4IR digitalization enablers such as big data, augmented reality and virtual reality. The implementation of the recommendations is expected to improve the supply chain efficiency and issues around the ERP system. The results of this research study, such as the dissatisfaction with the approval times, supplier payment delays and procurement team responsiveness, reveal that these problems identified, also occur in other HEIs in South Africa. This means that the universities must benchmark and align the processes have some uniformity across the higher education landscape and enabling knowledge sharing on processes, thus improving supply chain efficiency across the sector. The next phase of this study is to check how the improvements over time, through the tracking of key performance indicators in regular intervals. The learnings can then be shared through further publications and be implemented across the higher education sector.

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