DBA AFRICA MANAGEMENT REVIEW

2023

VOLUME 13 NO 3

LEAN THINKING AND PERFORMANCE OF PUBLIC AND PRIVATE CHARTERED UNIVERSITIES IN KENYA

Eucabeth A. Odero
X.N. Iraki
Gituro Wainaina

A QUARTERLY PUBLICATION OF THE DEPARTMENT OF BUSINESS ADMINISTRATION, FACULTY OF BUSINESS AND MANAGEMENT SCIENCES (FBMS) UNIVERSITY OF NAIROBI

ISSN NO: 2224-2023

http://uonjournals.uonbi.ac.ke/ojs/index.php/DBAAMR ISSN - 2224-2023
September 2023 Vol 13 No 3 Pgs 37 - 61

DBA Africa Management Review

Received Date
04/09/2023
Review Date
11/09/2023
Accepted Date
26/10/2023

LEAN THINKING AND PERFORMANCE OF PUBLIC AND PRIVATE CHARTERED UNIVERSITIES IN KENYA

Eucabeth A. Odero[1]; X.N. Iraki[2]; Gituro Wainaina[3]

Abstract

The changing operating environment of Higher Education Institutions (HEIs) worldwide, characterized by stiff competition, ever increasing student numbers and steadily decreasing government funding has led universities to constantly deal with operations management issues such as capacity planning, productivity, quality, efficiency and resource utilization. These trends have created the need for universities to adopt new business world management practices *that focus on improving the processes that deliver the services.* One approach that has successfully been used in manufacturing and is increasingly being adopted in the service sector, including HEIs, is lean thinking. The objectives of this study were: to assess the state of lean thinking in public and private chartered universities in Kenya and, to determine the relationship between lean thinking and performance of these institutions. A cross-sectional survey research design was employed and both primary and secondary data collected. The study population comprised 49 chartered universities which included 31 public and 18 private universities. From a purposive sample of 34 universities (20 public and 14 private), a questionnaire was administered to the academic registrars and 18 public and 10 private universities responded, giving response rates of 90 percent for public and 71.4 percent for private universities. Secondary data used to measure university performance were obtained from relevant websites and respective universities' records. Results indicated firstly, that although no university in Kenya had explicitly declared that it had implemented lean thinking, the concept was well known to the institutions. However, institutional-wide application of the concepts was moderate in public but was to a large extent in private universities. Secondly, lean thinking had a significant effect on performance of both public and private chartered universities in Kenya but with private universities showing stronger predictive power. The study affirms that lean thinking can improve performance of public and private chartered universities in Kenya. Policy makers can use these findings to formulate policies focused on efficiency, waste elimination and customer value. The findings are further expected to stimulate implementation of lean thinking in institutions of higher learning in general and universities in particular across Kenya and other developing countries. A holistic approach to lean thinking implementation is recommended for chartered universities in Kenya to improve their performance and remain competitive. Future research may concentrate on waste identification and elimination in Kenyan university processes in order to improve overall performance.

Key Words: Lean thinking, university performance, chartered universities, Kenya

[1] Faculty of Business and Management Sciences, University of Nairobi – *euodero@yahoo.com*
[2] Professor, Faculty of Business and Management Sciences, University of Nairobi - *xniraki@gmail.com*
[3] Professor, Faculty of Business and Management Sciences, University of Nairobi - *wainainagituro@yahoo.com*

Introduction

The changing operating environment of Higher Education Institutions (HEIs) worldwide, characterized by stiff competition, ever increasing student numbers and steadily decreasing government funding has led universities to constantly deal with operations management issues such as capacity planning, productivity, quality, efficiency and resource utilization (Goldstein, Miller, & Courson, 2013; OECD, 2016). At the same time, universities are under pressure, not only to produce more and better-trained and skilled graduates, but also to do so with minimum amounts of resources, which include: human effort, time, space, equipment and budget (Soares, Steele, & Wayt, 2016). Authors argue that these trends have transformed universities from public service to market-driven entities creating the need for the adoption of new business world management practices and a change of institutional mindsets (Kedem, 2011; Knuf, 2010). Lean thinking is one such an approach that has been used in manufacturing with tremendous success to gain competitive advantage and performance excellence (Ho, 2006; Yamamoto, Milstead, & LIoyd, 2019), and is increasingly being adopted in the service sector, including HEIs (Kroes, Manikas, & Gattiker, 2018; Rayate & Khairnar, 2018; Sercan & Turan, 2021).

Lean thinking, being a management philosophy and a process optimization strategy, aims to identify and eliminate steps or activities in the value-creation processes that add no value to the end-users but consume resources (waste) (Sua´rez-Barrazaa, Smith, & Dahlgaard-Park, 2012). It applies tools and techniques to develop a change in organizational culture to one that fosters operations and process improvement practices, which allow for reduction of wastes, improvement of flow and greater focus on customer needs (Ohno, 1988), and it is anchored on five core principles. Ziskovsky and Ziskovsky (2007) affirm that waste directly causes inefficiency, increased costs, process delays (time element), variation in the quality of process outcome, unnecessary consumption of resources and diminished performance.

Higher education in Kenya has been identified as the principal stimulus towards the attainment of the social pillar in the Vision 2030 which places greater emphasis on aligning education and training with the skills needs of the employment market and the society at large (World Bank, 2019). However, performance of universities has been under criticism from the government, employers and other stakeholders. Concern over graduate quality is on the rise (Federation of Kenya Employers, 2018; Munene, 2016); high operating costs with escalating debt levels (Mutai, 2019; Nganga, 2018) and inefficient use of resources (Ligami, 2017; Magoha, 2019) have become widespread among Kenyan universities. Although most universities have initiated a number of cost reduction measures, their systems and processes have remained fundamentally unchanged. This study therefore sought to evaluate the state of lean thinking in public and private chartered universities in Kenya and determine the

relationship between lean thinking and performance of these institutions.

Lean Thinking

The concept of "Lean" has its origins in the manufacturing system of a Japanese automobile company, Toyota, where it was first termed as the "Toyota Production System" (TPS). Lean was an initiative to correct the delays and duplications that were characteristic of a number of Toyota Company's mass production processes after the Second World War. During this period, the Japanese economy was faced with scarcity of input resources in terms of capital, raw materials and qualified labour, and the manufacturers had to" do more with less" (Liker, 2004). Over time, the lean concept evolved, attracting new terminologies including lean manufacturing, lean production (Krafcik, 1988), lean thinking (Womack, Jones, & Roos, 1990) and lately, lean enterprise (Womack & Jones, 1996; 2003), as it increasingly became adopted in other Toyota processes different from high volume repetitive manufacturing, and also spread to the service sector (Womack & Jones, 2003).

The definition of lean thinking varies with different authors and practitioners. Womack and Jones (1996) describe lean thinking as a "Systematic approach to identify and eliminate waste by aligning value-creating activities in the best sequence, carrying them out with no interruptions, and only when the customer requires them" (p 10). Radnor and Bucci (2011) look at lean thinking as a continuous improvement strategy with universal application as it emphasizes on improving processes. The authors observe that the lean methodology prioritizes the customer, develops thinking people and creates a workplace that enthusiastically supports and nurtures improvement. Hines and Lethbridge (2008) summarize these perspectives by viewing lean thinking from both strategic and operational level focus. The authors state that while focus is on principles at the strategic level (understand value), it is on tools at the operational level (eliminate waste).

Waste (or "muda" in Japanese) has been described as any activity that a customer would not want to pay for and that which adds no value from the customer perspective (Kusler, 2011). Ohno (1988) and Shingo (1981) came up with the first seven categories of muda that were typical of a manufacturing setting, namely: inventory, transportation, motion, overproduction, over-processing, waiting, and defects. In higher education systems, similar wastes have been identified, translated in the higher education context and grouped into four broad categories (Lareau, 2003), namely: People waste (arising when universities fail to make full use of the skills, abilities and knowledge of employees); asset waste (arising when the university fails to use its resources, for example, facilities, financial, human and materials, in the most efficient way); process waste (arising from deficiencies in the design and/or implementation of the university processes), and information waste (arising when available information is inadequate for purposes of supporting university processes).

The five core principles on which lean thinking is anchored were summarized by Womack and Jones (1996) as: Value (value specified from customer perceptive); value stream (a series of value-adding activities identified for a specified product or service); flow (processes are synchronized to allow for continuous flow of physical products, services and information); pull (production or operations are aligned to precisely meet customer demand), and perfection (constantly striving to eliminate waste, improve flow and satisfy customer needs through continuous improvement). Among the lean tools and techniques that have commonly been applied in the Higher Education (HE) environment to assist in mapping processes, managing workflows and eliminating waste include: Value Stream Mapping (VSM), Just In Time (JIT), production balancing and the 5Ss standardization (Radnor & Bucci, 2011).

Chartered Universities in Kenya

Universities in Kenya are regulated by the Commission for University Education (CUE), whose mandate include accreditation of the universities, coordination of long-term planning for university education and offering advice to the government concerning establishment of new universities (CUE, 2014). The universities operate in three categories, namely: Chartered universities, constituent colleges and institutions with Letters of Interim Authority (LIA), all of which constitute accredited universities. Chartered universities consist of public and private universities that have been granted permission to confer their own academic awards to those qualified in accordance with the provisions of the Universities Act 2012. The CUE List of Accredited Universities of 2017 (CUE, 2017) indicated that the number of private and public universities had grown to 74, up from 58 in 2011. Out of the 74 accredited universities, 31 were public and 18, private universities with full charter, compared to 7 public and 8 private universities in 2011. Private universities are non-state owned and exist in two categories, namely: for-profit and not-for profit (or faith-based) institutions.

Public universities are financed by the government through grants for both recurrent and development expenditure. They also receive external aid and contributions mostly for capital development, staff training and technical assistance. Comparatively, private universities rely on own funding sources which include tuition fees, endowments, gifts and trusts, and auxiliary enterprises and investments, with tuition fees being the main source, charged generally in conformance to market forces centered on full cost recovery. Although private universities are currently being funded by the national government on the basis of the number of government sponsored students admitted by them, the public universities still get a larger proportion of the same. It is however noted that from the early 1990s, the total budgetary allocations to public universities per capita (total university expenditure per student) had been declining (Mutula, 2002). This brought about the establishment of cost-sharing initiatives in

terms of fees as well as increased involvement in auxiliary enterprises and investments, sponsored research efforts and fund-raising activities (Oanda, Chege, & Wesonga, 2008). As a result, public universities resorted to fee-paying or parallel degree programmes to help them generate their own finances in order to remain operational.

University Performance

Robbins (2002) defines performance as the aggregate outcome of all the activities and work processes of an organization. Armstrong (2006) suggests that performance needs to be viewed as the output of work an organization undertakes, quantified into the objectives it wants to achieve. In higher education, these objectives develop from the university missions which, according to Twidale and Nichols (2013) are generally categorized as teaching, research and extension or community engagement.

Performance of HEIs can also be categorized as objective (quantitative) and subjective (qualitative) performance (Kontoghiorghes, Awbrey, & Feurig, 2005). Among the objective performance measures are financial (costs and revenues); student admission levels; quantities of research grants achieved, number of research publications, retention and graduation rates, student-faculty-ratios and facility utilization. The subjective performance indicators include teaching quality, graduate quality, knowledge-creation, innovation, web ranking, institutional reputation, customer satisfaction and, infrastructure such as buildings, learning spaces, library and Information and Communication Technology (ICT) facilities (Brodhag, 2013; Rossi & Rosli, 2013). This study concentrated on financial as well as non-financial measures of performance. Financial performance was measured using the current ratio and operating cost recovery ratio. These indicators were deemed appropriate given the financial crises facing most Kenyan universities today. Non-financial performance measure included web ranking and graduation rate. These indicators have been identified as critical performance measures of time and quality at strategic levels (Gibbs, 2010; Noreen & Hussain, 2019).

Research Problem

There is growing evidence in Kenya, that the quality of university education, which is a critical performance measure, has been declining (Kagondu & Marwa, 2017; Makokha & Mutisya, 2016). Complaints from employers are common that students' knowledge, skills and competencies that are critical to working in a fast changing technological environment are not adequately being addressed by the universities (Khainga & Mbithi, 2018). It is also in the public domain that most universities, particularly public, are sinking in financial crises, with cash flow problems, enormous liabilities and escalating debt levels (Mutai, 2019; Nganga, 2018; Owino & Wanzala, 2019).

Both the quality and financial problems have been attributed partly to the rapid growth in enrolments which occurred from 2012, but

also on competition pressure. It is argued that growth in enrolments, which saw both private and public universities grow to 74 by 2017, up from 58 in 2011, had occurred without commensurate expansion in resources, infrastructure and human capital, particularly in public universities (Gudo, 2014; Kyama, 2017), and in turn affected the quality of learning, teaching and research (Ogeto, 2015). With regard to competition, both private and public universities are increasingly competing among themselves and also regionally to offer students quality education, flexible programmes and user-friendly, online student services. These led to quantitative growth in satellite campuses and colleges which in turn contributed to inefficiency in the use of resources and facilities, leaving a number of universities struggling with severe cash flow problems (Ligami, 2017; Nyangau, 2014).

In an effort to address the above challenges, the government, through a CUE directive in 2017, closed a number of satellite campuses and suspended further establishment of new ones. Similarly, a number of universities in the recent past had embarked on a raft of measures to cut down on costs including hiring freezes, work-force reductions, internal reorganizations and widespread cutbacks across their institutions (Igadwah, 2018; Kariuki, 2019; Wanzala, 2018). However, the impact has been minimal as most universities, particularly public, are still cash-strapped (Sunday, 2022). In view of the limited success of these interventions, this study proposed that Kenyan universities should focus on eliminating waste in their systems and processes and lean thinking could be a sustainable approach.

Literature indicates growing interest in lean thinking application in HEIs with improvements in cost, quality, efficiency, customer value and overall institutional performance. However, many studies are case studies on projects initiated by HEIs that either were in the process of implementation or had already implemented lean thinking (Behm, Deseck, Granza, & Hermansen, 2010; Comm & Mathaisel, 2005; Pedersen, Ziegler, & Holt, 2015; Radnor & Bucci, 2011). In addition, majority of cases reviewed were from the United States of America (USA) (Behm, et al., 2010; Pedersen, Ziegler, & Holt, 2015); United Kingdom (UK) (Douglas, Antony, & Douglas, 2015; Radnor & Bucci, 2011), and Asia (Alex, Lokesh, & Ravikumar, 2010; Rayate & Khairnar, 2018), where most HEIs are operating in intense competitive market environments, necessitating the need to adopt private sector management practices.

In Kenya, researches on lean thinking application in a university set-up are scarce. A number of studies on lean concepts have concentrated in the areas of manufacturing (Keitany & Riwo-Abudho, 2014; Wamalwa, Onkware, & Musiega, 2014); microfinance institutions (Madiavale, 2016), and areas of supply chain (Mwangangi & Achuora, 2019) and procurement (Nyakagwa & Muthoni, 2014), and have reported significant cost savings, lead-time reductions, quality improvements and enhanced customer satisfaction. This study therefore sought to bridge these gaps by looking for answers to

the broad research question: What is the influence of lean thinking on performance of public and private chartered universities in Kenya?

Literature Review

Lean thinking was underpinned in this study by the Theory of Constraint (TOC). The TOC takes a systems view of the organization where people, parts, processes and resources work in an interdependent manner to achieve organizational goals (Liker & Meier, 2006). Originally coined by Goldratt (Goldratt & Cox, 1984), the theory assumes that every complex transformational process consists of a chain of interlinked activities of which at least one, the weakest link, acts as a constraint (referred to as bottleneck in a manufacturing setup). It further posits that improvement in the overall throughput can only be achieved by improving the constraint. The relevance of TOC in lean thinking is embedded in the similarities of its belief with the lean principles and importantly its view on the concept of "waste". While Goldratt and Cox (1992) acknowledge that waste forms an integral part of most constraints, the lean methodology identifies waste as the main restriction to profitability (KPMG, 2012).

Lean Thinking and Performance of Universities

According to Chhatrawat and Dixit (2016), the important goals of a lean thinking system are waste elimination, quality improvement, time saving, cost reduction and improvement in customer satisfaction. Wood and Nigel, (2004) explain that by identifying and eliminating waste, the organization can simultaneously reduce costs, improve quality, make better use of resources and deliver better customer value, leading to increased overall organizational performance. Douglas, Antony and Douglas (2015), supported by Comm and Mathaisel (2005) argue that the efficiency and effectiveness of any educational system rise from its ability to achieve its goals with the least cost and resources possible. Findings on the research by Comm and Mathaisel (2005) revealed that implementation of cost reductions or containment initiatives through the adoption of lean principles and tools brought about increased effectiveness and sustainability of HEIs. The purpose was to examine sustainability of lean initiatives being undertaken in the USA and to find out the "best practices" that were being developed at these institutions. In contrast, Radnor and Bucci (2011) in similar studies in UK universities and business schools, established little evidence relating to savings in cost, but identified positive results related to student and staff experiences in terms of improved communication; recruitment and training of staff; student admissions, maintenance procedures, financial data processing and in decision making. However, a study by Pedersen, Ziegler and Holt (2015) aimed at improving student's learning experience while at the same time cutting costs on a project at a distance education division of Northern Arizona University (NAU), established significant cost savings in organizational operations through lean

implementation. One of the projects (new student orientation) realized an annual cost savings of $6,750.

Time is a significant determinant of performance in organizations and is increasingly being used as a management tool for achieving competitive advantage. Behm, et al. (2010) examined the level of success of the lean initiatives being implemented in the University of Michigan, USA. The study identified a number of improvements in efficiency especially in operations, with enormous process time reductions in Health Care (HC) system and Human Subject Incentive Program (HSIP), leading to enormous cost savings. These results were supported in later findings by Isaksson, Kuttainen and Garvare (2013) and Oktarian and Surjasa (2021) in their studies aimed at assessing how traditional university research and education were performing compared with cases where lean principles were applied in Sweden and in Indonesia respectively. In Sweden, findings revealed that the time lag between idea creation and research publication in most universities varied between 10 to 40 months against a benchmark of one to three months. This signified about 90 percent waste in the form of waiting. While the long summer holidays were viewed as representing waste within the educational process, the visionary benchmark was individualized and based on "one-piece-flow". In Indonesia similarly, results indicated that the waste level in the form of waiting time was 90% longer than the benchmark time for both the education and research processes. By upgrading the processes through lean application, the time wasted reduced to as low as 10%.

The quality of higher education has become strategically important in national economic development and competitiveness. Gibbs (2010) argues that effective measures of education quality should focus on variables that relate to improvements in quality of the learning outcomes. Sillero (2013) in a project aimed at experimenting and evaluating the benefits of a Project-Based Learning (PBL) method to increase the learning outcomes in the teaching-learning process at the Engineering Department of the University of Monterey (México), realized a 9 percent increase in the general satisfaction of students compared with previous cohorts. A project similar to the above was carried out by Pusca and Northwood (2016) aimed at determining how application of lean principles could help in improving the quality of a course design in an engineering programme, focusing on the three core areas of course content, instructional methods and methods of assessment. Findings revealed significant improvements in students' engagement as a number of changes were implemented including the use of the flipped teaching, which created more time for the new content design, group work and practical examples, which in turn encouraged more active learning with hands-on experiences.

Research Methodology

Cross-sectional survey research design was employed. This design is suitable in situations where the researcher engages in either or both descriptive and analytical

research types at a point in time (Kothari & Carg, 2014), which are relevant to this study. The study population consisted of 49 chartered universities which included 31 public and 18 private universities. However, the study targeted those universities that had been awarded full charter by 2013, leading to a purposive sample of 34 (20 public and 14 private). In order to avoid the possibility of duplication of information arising from multiple responses, one respondent, the academic registrar, from each university, was selected, as their role provide a vital link between the executive and the core university mission of teaching.

Secondary data was obtained from various universities' records, websites and audited annual financial reports; CUE reports, together with Webometrics Ranking of World Universities and uniRank websites, over a period of five years, from 2016/2017 to 2020/2021 academic years. Five-year averages were taken for the current ratios, operating cost recovery ratios, graduation rates and web rakings so that time series data would match with cross-sectional data. Graduation rates were based on the first-time, full-time, 4-Year programme undergraduate enrolments from 2013/14 to 2017/18.

Data collected was analyzed using both descriptive and regression techniques. For objective one which sought to assess the state of lean thinking in public and private chartered universities in Kenya, descriptive statistics, including the mean, percentages, frequencies and standard deviation was used. On the other hand, for objective two which involved tests of hypothesis aimed at determining the effect of lean thinking on performance of public and private universities in Kenya, linear regression analysis was applied.

Results and Discussions

Out of the 34 questionnaires distributed a total of 30 were correctly filled and returned, 18 from public and 12 from private universities. However, two private universities declined to provide financial data and were excluded on the basis of incomplete data. The study, therefore achieved response rates of 90 percent for public, 71 percent for private universities and 83 percent overall.

State of Lean Thinking in Public and Private Chartered Universities in Kenya

The study first assessed the respondents' level of awareness of the lean thinking concept in terms of their knowledge of the concept, personal workplace application and institutional-wide application of the concept. On each of these, the respondents were requested to give their views on the stated statements based on a scale of 1-5, described as: 1 (very low); 2 (low); 3 (moderate); 4 (high) and 5 (very high). The results were summarized in

Table 1 below.

Table 1: Respondents' Awareness and Use of the Lean Thinking Concept

Characteristics	Rating	Public Universities		Private Universities	
		Frequency	Percent	Frequency	Percent
Level of knowledge of the lean thinking concept	Very low	1	6	0	0
	Low	2	11	0	0
	Moderate	8	44	1	10
	High	7	39	6	60
	Very high	0	0	3	30
	Total	18	100	10	100
Level of use of lean application in day-to-day work	Very low	0	0	0	0
	Low	2	10	1	10
	Moderate	6	30	2	20
	High	10	60	5	50
	Very high	0	0	2	20
	Total	18	100	10	100
Level of institutional-wide application of lean thinking in the university	Very low	0	0	0	0
	Low	3	17	0	0
	Moderate	12	66	0	0
	High	3	17	6	60
	Very high	0	0	4	40
	Total	18	100	10	100

Source: Research Data (2022)

Results of

Table 1 above indicated that in public universities, 44% of the respondents agreed that their level of knowledge of the concept of lean thinking was moderate; 60% indicated that their personal workplace application was high, and 66% indicated institutional-wide application of the lean concept was moderate. In private universities, on the hand, 60% of the respondents indicated high levels for knowledge of the concept; 50% for high levels of personal workplace application, and 60% for high levels of institutional-wide application of the lean concept. These results indicate that overall, the concept of lean thinking was well known and applied at individual levels in both public and private universities but institutional-wide application was moderate in public but high in private universities.

The study further evaluated the level of application of lean principles and the practice of waste elimination in public and private chartered universities. Descriptive measures which were used to summarize the characteristics of the study variables included the mean and the standard deviation. A summary of the results for public and private universities was shown Table 2 below

Table 2: Summary of Lean Thinking Descriptive Analysis

Study Variable	Sub-Variables	Indicators	Public Universities		Private Universities	
			Mean	Standard Deviation	Mean	Standard Deviation
Lean thinking	Lean principles	Value	3.89	1.08	4.38	0.57
		Value stream	3.39	1.28	4.04	0.83
		System flow	3.48	1.08	4.02	0.77
		Customer pull	2.96	1.33	4.03	0.86
		Perfection (continuous improvement)	3.38	0.97	3.73	1.03
		Mean score for principles	3.42	1.15	4.04	0.81
	Waste elimination	People waste	3.01	1.04	3.79	1.01
		Asset waste	2.78	1.09	4.12	0.74
		Process waste	3.17	1.16	4.02	0.87
		Information waste	3.49	1.23	4.07	0.93

		Mean score for waste elimination	3.11	1.13	3.96	0.94
	Overall mean and standard deviation for lean thinking		3.28	1.14	4.02	0.85

Source: Research Data (2022)

Findings in Table 2 showed that lean principles were being applied to a moderate extent in public universities (aggregate mean score of 3.42, standard deviation of 1.15) but to large extent (mean score of 4.04 and a standard deviation of 0.81**)** for private universities**.** On waste elimination, the results reflected a mean of 3.11 and a standard deviation of 1.13 for public universities and an aggregate mean score of 3.96 and a standard deviation of 0.94 for private universities. These indicated that according to the respondents, the lean practice of waste elimination was being applied to a moderate extent in public universities and to a fairly large extent (mean of 3.96 is close to 4) in private universities. Overall, the results indicated a moderate application of lean thinking in public universities (aggregate mean score of 3.27 and less variability with a standard deviation of 1.15) but with private universities showing a large extent of application (aggregate mean score of 4.01 and less variability with a standard deviation of 0.86). On individual lean principles, the "value" category, which entails the definition of value from customer perspective was ranked highest for both public and private universities but with private universities showing superior level of application (mean score of 4.08 and standard deviation of 0.68) than public (mean score of 3.66 and standard deviation of 1.18). On the other hand, customer pull which entails understanding the customer demand and creating processes to respond accordingly, was rated lowest in public universities (mean score of 2.96 and standard deviation of 1.33), as compared to a large extent application in private universities (mean score 4.03 and less variability with a standard deviation of 0.86).

On individual waste elimination practices, Table 2 further indicated that asset waste, which refers to the category of wastes that occur when the university does not use its resources (human, facilities, financial, and materials) in the most effective manner, had the highest overall elimination mean score of 4.12 and a standard deviation of 0.74 (less variability) in private universities, while in public, it was ranked the lowest (mean score of 2.78 and a standard deviation of 1.09). These meant that on average, asset waste was rampant in public universities, while such kind of waste was nearly completely eliminated in private universities. This could have contributed to the generally low performance, particularly financial, in public universities as compared to their private university counterparts.

Performance of Public and Private Chartered Universities in Kenya

Performance was expressed in both financial (current and operating cost recovery ratios) and non-financial (graduation rate and web raking) terms. Since measurements for performance indicators involved both interval and ordinal scales, the resulting data were grouped and assigned weights on a scale of 1-5 in order to match with the questionnaire ratings and create uniformity in data analysis.

Operating cost ratio refers to the extent to which the university revenues are able to recover its operating costs. Data collected were categorized into scores ranging from "below 0.90" (very weak) to "1.20 and over" (very strong), and summarized in Table 3 below:

Table 3: Comparison of Cost Recovery Ratio Between Public and Private Universities

Operating Cost Recovery Ratio Weights	Cost Recovery Ratio Ranges	University Category			
		Public		Private	
		Number	Percent	Number	Percent
1	Below 0.90	2	11	0	0
2	0.90 to 0.99	8	44	1	10
3	1.00 to 1.09	7	39	5	50
4	1.10 to 1.19	1	6	3	30
5	1.20 and Over	0	0	1	10
Total		18	100	10	100

Source: Research Data (2022)

Table 3 indicates that majority of public universities (55 percent) had operating cost recovery ratios of less than 1, with 44 percent falling between 0.9 and 0.99. In contrast, only 10 percent of private universities studied fell within the same range. The implication is that most public universities were operating at a deficit as their revenues were unable to recover their operating costs. In addition, 39 percent of public universities were just breaking even, with their operating cost recovery ratios falling within the "1.00-1.09" range. In comparison, a higher percentage of private universities (50 percent) fell within this range. It was further noted that only 6 percent (1 out of 18) of public and 30 percent (3 out of 10) of private universities studied had an average operating cost ratios of between 1.10 and 1.19.).

According to Xiaocheng (2010), operating cost recovery ratios for financially healthy universities should typically lie between 1.10 and 1. 15. Overall only 18% (5 out of 28) of the universities studied were, as such, financially healthy. These findings were in line with the Auditor General's report for the financial years 2017/2018 which indicated that majority of public universities, particularly the older ones, were in deep

financial crises, operating with huge deficits, some of which were resorting to short-term bank overdrafts to finance their operations (Mutai, 2019). The situation has continued to deteriorate as highlighted by the National Treasury's report for the financial year 2020/2021, raising concern over these institutions' ability to sustain their operations (Sunday, 2022).

Current ratio refers to the extent to which the university is capable of meeting its immediate financial commitments in its ordinary operations. According to Mulholland (2017), a current ratio of 1.5 or greater would, in general, indicate sufficient liquidity for an institution of higher learning, while a good current ratio for profit-oriented institution would typically be between 1.5 and 2.0. Data collected for current ratios were also categorized into scores ranging from "below 0.60" (very weak) to "1.80 and over" (very strong). A summary of the results were shown in Table 4 below:

Table 4 Comparison of Current Ratios Between Public and Private Universities

Current Ratio Weights	Current Ratio Ranges	University Category			
		Public		Private	
		Number	Percent	Number	Percent
1	Below 0.60	1	1	0	0
2	0.60 to 0.99	9	9	2	20
3	1.00 to 1.39	6	6	6	60
4	1.40 to 1.79	2	2	1	10
5	1.80 and over	0	0	1	10
Total		18	18	10	100

Source: Research Data (2022)

Table 4 above showed that majority of public universities, 56 percent (10 out of 18) had their current ratios less than 1.00, with 50 percent falling between 0.9 and 0.99. In contrast
, only 20 percent (2 out of 10) of private universities studied fell within this range. Consequently these institutions might struggle to meet their short-term financial obligations as, and when, they fall due. In addition, 33 percent of public universities were breaking even, with their current ratios falling within the "1.00-1.39" range. In comparison, a higher percentage of private universities (60 percent) fell within the same range. It was further noted that 11 percent (2 out of 18) of public and 20 percent (2 out of 10) of private universities studied had an average current ratio lying within 1.40 and above. These implied that in general only 11 percent of public and 20 percent of private universities met the criteria for being in a sound liquidity position for an institution of higher learning as recommended by

Mulholland (2017). Overall, only 14 percent (4 out of 28) of universities studied enjoyed sound liquidity.

The above findings corroborate the reports of the Auditor General for the financial years 2016/2017 and 2017/2018 highlighted by the daily newspapers. The reports revealed that several public universities were technically insolvent, with cash flow problems, enormous liabilities and escalating debt levels in terms of unremitted taxes, staff pensions, bank loan deductions for staff, Savings & Credit Cooperative (SACCO) deductions, National Hospital Insurance Fund (NHIF) deductions, and National Social Security Fund (NSSF) deductions among others. The situation has since worsened, particularly for older universities as warned by the Auditor General's Office that for the financial year 2020/2021, majority of public universities' liabilities exceeded their assets, putting to question their sustained survival unless bailed out by the state (Sunday, 2022).

Graduation rate indicates a country's capacity to supply future human resource with specific knowledge and skills (Mukhwana, et al., 2016). In the current study context, graduation rate refers to the percentage of first-time, first-year undergraduate students who graduate within the stipulated time for the programme**.** The study focused on the 4-Year undergraduate programme. A summary of the results for graduation rates were shown in Table 5 below:

Table 5 Comparison of Graduation Rates Between Public and Private Universities

Graduation Rate Weights	Graduation Rate Ranges	University Category			
		Public		Private	
		Number	Percent	Number	Percent
1	Below 50	1	6	0	0
2	50 to 59	5	27	0	0
3	60 to 69	7	39	5	50
4	70 to 79	4	22	4	40
5	80 and over	1	6	1	10
Total		18	100	10	100

Source: Research Data (2022)

Table 5 indicated that 39 percent of public and 50 percent of private universities had average graduation rates within the "60 to 69 percent" range. Comparatively, 33 percent of public universities and none of the private universities fell within the "below 60 percent" range. Table 5 further showed that 28 percent of public and 50 percent of private universities had their average graduation rates falling within "70 percent and above" range, implying that on average, 70 percent and above, of these universities' four-year bachelor's degree students graduate within the stipulated timeframe for

the programme. Overall, a higher percentage of students in private universities complete their bachelor's degree at the same university within the recommended time for the programmes than those in public universities. These findings were partly supported by a CUE audit of universities conducted in January and February 2017 which established rampant cases of missing marks and transcripts in public universities, which led to students' frustration and sometimes resulting in deferred graduation (CUE, 2017).

The combined analysis of the data collected revealed that the overall average graduation rate for public universities was 61 percent, while that of private was 75 percent, and overall for all the universities was 66 percent. This implied that on average, 61 percent of public and 75 percent of private universities' four- year undergraduate students had completed a bachelor's degree at the same institution where they started within four years. The results were closely comparable with international figures although the number of universities covered under the current study was significantly small. According to the U.S. National Center for Education Statistics, the average college four-year undergraduate graduation rate (based on universities and colleges in 50 states) for the year 2020 was 64 percent. It was however noted that the top performing universities and colleges often maintained graduation rates above 90 percent. For example, Harvard had a graduation rate of 98 percent, while Yale University, a graduation rate of 97 percent. Stanford and Massachusetts each had graduation rates of 94 percent (National Centre for Education Statistics, 2021).

Web ranking refers to the extent to which the university exhibits quality of teaching, research and knowledge transfer, as reflected by the level of web presence. Web rankings were based on an average of 57 registered public and private universities in Kenya that had consistently taken part in the national rankings from 2017 to 2021. The findings were summarized in Table 6 below.

Table 6 Comparison of Web Rankings for Public and Private Universities

Web Ranking Weights	Web Ranking Ranges	University Category			
		Public		Private	
		Number	Percent	Number	Percent
5	1 to 9	3	17	2	20
4	10 to 19	2	11	4	40
3	20 to 29	8	44	2	20
2	30 to 39	4	22	0	0
1	40 and over	1	6	2	20
Total		18	100	10	100

Source: Research Data (2022)

Table 6 above indicated that 3 out of 18 (17 percent) of public and 2 out of 10 (20 percent) of private universities under study ranked within positions "1 to 9" range, out of an average of 57 participating institutions in national rankings. In addition, 8 out of 18 (44 percent) of public and 2 out of 10 (20 percent of private) universities ranked between positions 20 to 29. These implied that from positions 1 to 29, which should be a benchmark for the 28 universities under study, 72 percent (13 out of 18) of public and 80 percent (8 out of 10) of private universities were included. These indicated that in general, private universities had superior performance over their public universities counterparts with regard to web ranking.

Lean Thinking and Performance of Public and Private Chartered Universities in Kenya

In the second objective, the study sought to determine the effect of lean thinking on performance of public and private chartered universities in Kenya. The related null hypothesis stated that there is no significant effect of lean thinking on performance of public and private chartered universities in Kenya. Regression results for public and private universities were summarized in Table 7 below as model 1 (private universities) and model 2 (public universities).

Table 7 Regression of Private and Public Universities Performance on Lean Thinking

(a) Model Summary						
Model	R	R Square		Adjusted R Square		
1	.943[a]	.889		.876		
2	.748[b]	.560		.532		
(b) Goodness-of-Fit ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.757	1	1.757	64.343	.000[b]
	Residual	.218	8	.027		
	Total	1.975	9			
2	Regression	3.080	1	3.080	20.361	.000c
	Residual	2.420	16	.151		
	Total	5.500	17			
(c) Beta Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t-value	Sig.
		B		Beta		
1	(Constant)	-.956			-1.836	.104
	Lean Thinking	1.254		.943	8.021	.000
	(Constant)	-.553			-.714	.485

2	Lean thinking	1.121	.748	4.512	.000
a. Dependent Variable: University Performance					
b. Predictors: (Constant), Lean Thinking,					

Source: Research Data (2022)

Results in Table 7 above indicated a coefficient of determination (R^2) in model 1(private universities) of 0.889, and 0.560 in model 2 (public universities), implying that 88.9 percent and 56.0 percent of the total variation in performance of private and public chartered universities respectively, were accounted for by lean thinking. The Analysis of Variance (ANOVA) results for both private and public universities indicated that the overall models were significant since p-values were lower than 0.05 ($P<0.05$), and the null hypotheses which stated that there was no significant effect of lean thinking on performance of public and private chartered universities in Kenya, were rejected. The study concluded that lean thinking positively and significantly influences performance of both private and public universities in Kenya, but with predictive power being stronger in private universities, and only moderate in public universities.

On individual significance, the regression coefficient results in Table 7 further showed a beta coefficient for lean thinking as 1.254 with a p-value of 0.000 ($p<0.05$) in relation to private universities, and 1.121 with a p-value of 0.000 ($p<0.05$) with regard to public universities. However, the constants were not significant as the p-values, 0.104 for private and 0.485 for public universities were greater than α-value (0.05). The predictive regression equations therefore, were PPI = 1.254LTPI (for private universities) and was PPU = 0.748LTPU (for public universities), where PPI and PPU are composite indices for performance of private and public universities respectively, and LTPI and LTPU are the composite indices for lean thinking in private and public universities, respectively. On interpretation, if lean thinking in private and public universities were increased by one unit each, the university performance would go up, on the average, by 1.254 units for private universities and 0.748 units for public universities.

Summary, Conclusions and Implications

The objectives of the study were to explore the current state of application of lean thinking in public and private chartered universities in Kenya and, to determine the relationship between lean thinking and performance of these institutions. Objective one was evaluated by first assessing the respondents' awareness and use of the lean thinking concept, and secondly by assessing the level of application of lean principles and the extent of waste elimination in the university processes. The results indicated that overall, the concept of lean thinking was well known in both public and private chartered universities in Kenya but institutional-wide application was moderate in public and high in private universities. The

results further indicated that the lean principles and the practice of waste elimination were being applied to a large extent in private but only to a moderate extent in public universities.

In the second objective, the study sought to determine the effect of lean thinking on performance of public and private chartered universities in Kenya. The results showed that in both cases, lean thinking had significant and positive influence on performance of these institutions. However, private universities showed stronger predictive power in the relationship between lean thinking and university performance, over their public universities counterparts. .

Conclusions

The study concludes that the concept of lean thinking is not new to public and private chartered universities in Kenya, particularly at managerial levels, as reflected by respondents' high levels of knowledge of the concept, and high levels of lean application in their day-to-day work. However, institutional-wide application of the lean thinking concept is only moderate in public universities but high in private ones. The study also concludes that lean thinking positively influences performance of both public and private chartered universities in Kenya, with private universities showing stronger predictive power. These could partly explain moderate performance revealed in public universities while private universities exhibited generally higher performance.

Implications

The main contribution to knowledge of the current study is that it confirms, with prior empirical analysis and theoretical foundation that lean thinking has a positive and direct effect on university performance. This finding expands the body of knowledge on positive relationships between the lean thinking and organizational performance. The findings of the current study also have policy and managerial practice implications. Policy makers particularly in the Ministry of Education, Science and Technology in Kenya will be able to formulate policies focused on efficiency, waste elimination and customer value, thus saving on the constrained public budget while enhancing stakeholder satisfaction. In addition, the study found out that as the level of application of lean thinking increases, university performance will also increase. On the basis of this finding, the study recommends that managements of public and private chartered universities and similar institutions in Kenya undertake a holistic implementation of lean thinking in order to improve their overall performances.

Suggestions for Further Research

The current study assessed lean thinking application at strategic levels by using academic registrars of the universities as the key respondents. Since lean thinking is about creating value to the customers (who are primarily the students), it is recommended that a similar study be carried out involving students and lecturers. This would add to the

current study by capturing the effectiveness of lean thinking application at operational levels. In addition, the current study assessed the existence of waste in university systems and processes within the narrow confines of the questionnaire items. A detailed study should be carried out on waste identification and elimination in Kenyan universities, highlighting the nature and causes of these wastes to facilitate their removal, leading to improvement in overall university performance.

REFERENCES

Alex, S., Lokesh, A. C., & Ravikumar, N. (2010). Space utilization improvement in CNC machining unit through lean layout. *SASTECH Journal, 9(2)*.

Armstrong, M. (2006). *A handbook of human resource management, 10th edn.* London: Kogan Page.

Behm, J., Deseck, M., Granza, M., & Hermansen, S. (2010). *Lean thinking for business and finance.* Michigan, U.S.A: Leadership Academy, University of Michigan.

Brodhag. (2013). Research Universities, technology transfer, and job creation: What infrastructure, for what training? *Studies in Higher Education, 38(3)* , 388-404.

Chhatrawat, M. R., & Dixit, M. A. (2016). Leanp production system: A review. *Development, 3(3)*, 117.

Comm, C. L., & Mathaisel, D. F. (2005). An exploratory study of best lean sustainability practices In higher education. *Quality Assurance in Education: An International Perspective, 13(3)* , 227-240.

Douglas, J., Antony, J., & Douglas, A. (2015). Waste identification and elimination in HEIs: the role of lean thinking. *International Journal of Quality and Reliability Management, 32*, 970-981.

Federation of Kenya Employers. (2018). *Skills mismatch survey, Research Report, December, 2018, Nairobi, Kenya.* Nairobi: Federation of Kenya Employers.

Gibbs, G. (2010, September). *Dimensions of quality: Hgher education academy.* Heslington - York, UK: The Charlesworth Group.

Goldratt, E. M., & Cox, J. (1984). *The goal: Excellence in manufacturing.* New York: North River Press, Inc.

Goldratt, E. M., & Cox, J. (1992). *The goal: A process of ongoing improvement.* Great Barrington, MA: North River Press Publishing Company.

Goldstein, K., Miller, A., & Courson, J. (2013). *Reinventing leadership in higher education: A confidential survey of college presidents* . Retrieved from Witt/Kieffer Higher Education: www.wittkieffer.com (Accessed on January 20, 2016)

Gudo, C. (2014). Financing higher education in Kenya: Public – Private partnership approach. *International Journal of Educational Policy Research and Review,1(1)* , 001-005.

Hines, P., & Lethbridge, S. (2008). New development: Creating a lean university. *Public Money & Management, vol. 28, no. 1*, 53-56.

Ho, S. L. (2006). Six sigma and educational excellence. *IEEE International Conference on Management of Innovation and Technology, Vol.2* (pp. 21-23). Singapore: IEEE ICMIT.

Igadwah, L. (2018, August 14). *UoN drops tea, snacks, printing on paper as cash crunch bites*. Retrieved October 30, 2018, from Daily Nation Business Week: https://www.nation.co.ke › News › Education

Isaksson, R., Kuttainen, C., & Garvare, R. (2013). Lean higher education and lean research. *16th Toulon - Verona Conference, 29-30 August , 2013*. Lovenia: University of Ljubljana, Slovenia.

Kagondu, R., & Marwa, S. M. (2017). Quality issues in Kenya's higher education institutions. *JHEA/RESA, 15(1)*, 23-42.

Kariuki, W. (2019, May 10). *Kenyatta University in a financial mess and might stop operations – Auditor General.* Retrieved from Daily Nation Nairobi News: https://nairobinews.nation.co.ke/news/

Kedem, Y. (2011). *A Conceptual Framework For Applying Lean Management Methodology In Higher Education Institutions.* Retrieved October 10, 2013, from Shenkar College for Engineering and Design, Ramat-Gan, Mofet Institute, Tel-Aviv, Israel: http://www.mofet.macam.ac.il/prof/nihul/Documents/

Keitany, P., & Riwo-Abudho, M. (2014). Effects of lean production on organizational performance : A case study of flour producing company in Kenya. *European Journal of Logistics Purchasing and Supply Chain Management, 2(2)* , 1-14.

Khainga, D., & Mbithi, J. (2018). *Employment distribution of youth graduates across economic sectors in Kenya; KIPPRA Discussion Paper No. 214, 2018.* Nairobi, Kenya: Kenya Institute for Public Policy and Researh Analysis.

Knuf, J. (2010). *Transformation of higher education institutional structure and operations into a lean systems framework; lean systems in higher education (White Paper Draft Version 1.4).* Washington D.C.: US Department of Education.

Kontoghiorghes, C., Awbrey, S. M., & Feurig, P. L. (2005). Examining the relationship between learning organization characteristics and change, adaptation, innovation and organizational performance. *Human Resource Development Quarterly, 16(2)* , 185-212.

Kothari, C. R., & Carg, G. (2014). *Research methodology: Methods and techniques, Third Edition.* New Delhi: New Age International Publishers.

KPMG. (2012). *Beyond Capability Maturity Model Integration (CMMI). Accessed on 23 September, 2018.* Retrieved September 23, 2018, from kpmg.com: https://assets.kpmg/content/dam/kpmg/pdf/2016/04/Beyond-CMMI.pdf

Krafcik, J. (1988). The triumph of the lean production system. *Sloan Management Review, 31(1)*, 41-42.

Kroes, J. R., Manikas, A. S., & Gattiker, T. F. (2018). Operational leanness and retail firm performance since 1980. *International Journal of Production Economics, 197*, 262-274.

Kusler, K. (2011). *Lean university - Operational efficiency using lean principles.* Retrieved August 17th, 2013, from http://www.ncci: http://www.ncci cu.org/resourcelibrary/index.cfm?event=action.download.item&itemid=99

Kyama, R. (2017, April 21). Universities forge new partnership with industry. *University World News, Issue No. 195*.

Lareau, W. (2003). *Office kaizen: Transforming office operations into a strategic competitive advantage.* Milwaukee, Wisconsin: ASQ Quality Press.

Ligami, C. (2017, February 17). Kenya: "Eleven universities face insolvency – Report" . *University World News, Issue No, 443*.

Liker, J. (2004). *The Toyota Way – 14 management principles from the World's greatest manufacturer.* New York: McGraw-Hill.

Liker, J., & Meier, D. (2006). *The Toyota Way Field Book: A Practical Guide to implementing Toyota 4Ps.* McGraw Hill, USA.

Madiavale, E. M. (2016, November). Effect of lean practices on operational performance of microfinance institutions in Mombasa County. *(Unpublished Thesis for Master of Business Management (MBA), University of Nairobi*. Kenya, Kenya: University of Nairobi Repository.

Magoha, G. (2019, April 14). Republic of Kenya (2019): Critical issues in higher education sector . *Statement delivered by Prof. George Magoha, Cabinet Secretary, Ministry of Education, during the release of the 2019 Universities Results*. Catholic University of Eastern Africa (CUEA), Nairobi, Kenya.

Makokha, G. L., & Mutisya, D. N. (2016). Status of e-learning in public universities in Kenya. *International Review of Research in Open and Distributed Learning; 17(3)*.

Mukhwana, E., Oure, S., K. S., Kande, A., N. R., Too, J., & Some., D. (2016). *State of university education in Kenya.* Nairobi, Kenya: Commission for University Education, Discussion Paper 04.

Mulholland, B. (2017). *Ratio analysis of finanacial KPI in higher education sector: A case, Belfast.* Retrieved from https://www.academia.edu: https://www.academia.edu/35430468/Ratio_analysis_of_financial_KPI_in_the_Higher_Education_sector_a_case_study

Munene, I. (2016, February 17, 6.29am SAST.). *Kenya's universities are in the grip of a quality crisis*. Retrieved November 14, 2018, from The Conversation: Uploaded February 17, 2016 6.29am SAST. https://theconversation.com/kenyas-universities-are-in-the-grip-of-a-quality-crisis-54664

Mutai, E. (2019, May 9). *University of Nairobi sinks into Sh1.4 billion loss.* Retrieved June 6, 2019, from Business Daily (Online): https://www.businessdailyafrica.com/news/UoN-sinks-into-Sh1-4-billion-loss/539546-5107072-hcm9nf/index.html

Mutula, S. M. (2002). University education in Kenya: Current developments and future outlook. *International Journal of Educational Management, 16(3)* , 109 - 119.

Mwangangi, J., & Achuora, J. (2019). Influence of lean supply chain on performance of public universities in Kenya. *International Journal of Social Sciences and Information Technology V(V)*, 160-173.

National Centre for Education Statistics. (2021). *Condition for education (NCES 2020-144): Undergraduate retention and graduation rates.* Washington D.C., USA: U.S. Department of Education.

Nganga, G. (2018, October 26). Kenya: "University reels from US$5.8m loss as campuses shut". *University World News (Global Edition) , Issue No:523*.

Noreen, F., & Hussain, B. (2019). HEC ranking criteria in the perspective of Global University Ranking System. *Global Social Sciences Review (GSSR), Vol. IV, No. II*, 59-70.

Nyakagwa, G. O., & Muthoni, D. K. (2014). Factors affecting implementation of lean procurement in multinational enterprises: A case study of British American Tobacco (Kenya). *International Journal of Social Sciences and Entrepreneurship, 1(11)* , 395-417.

Nyangau, J. Z. (2014). Higher education as an instrument of economic growth in Kenya. *FIRE: Forum for International Research in Education, 1(1)*, 1-25.

Oanda, I., Chege, F., & Wesonga, D. (2008). *Privatisation and private higher education in Kenya; Implications for access, equity and knowledge production.* Dakar: Codesria.

OECD. (2016). *Education at a Glance 2016, Indicator B1 and B5* . Paris, France: OECD Publishing.

Ogeto, A. (2015, October 2015). *High student enrolment has led to shortage of facilities and services'*. Retrieved 8 6, 2018, from Daily Nation Newspaper: http://www.nation.co.ke

Ohno, T. (1988). *The Toyota Production System: Beyond large-scale production.* Portland: Productivity Press.

Oktarian, A., & Surjasa, D. (2021). The effect of lean on improving the quality of higher education in Indonesia. *Business and Entrepreneurial Review, 21(2)*, 217-230.

Owino, S., & Wanzala, O. (2019, May 9). *Multimedia and UoN battles debt crisis.* Retrieved July 14, 2019, from Daily Nation: https://www.nation.co.ke/news/UoN-broke-heavily-debt-says-auditor/1056-5107052-12lxmjz/index.html

Pedersen, K. L., Ziegler, M. J., & Holt, L. D. (2015). Striving for operational excellence in higher education: A case study implementing lean for distance lLearning. *Quality Approaches in Higher Education, 6(2)- (asq.org/edu)*.

Pusca, D., & Northwood, D. O. (2016). Can lean principles be applied to course design in engineering education?,. *Global Journal of Engineering Education, 18(3)* , 173-179.

Radnor, Z. J., & Bucci, G. (2011). *Executive summary – Analysis of lean implementation in UK business schools and universities, , pp. 1 – 74.* London: AtoZ Business Consultancy.

Rayate, K. A., & Khairnar, H. P. (2018). Identification of major lean production waste in Indian automobile industries;. *International Journal of Engineering Development and Research (IJEDR), 6(2)* , 812-819.

Robbins, S. P. (2002). *Management, 11th Edition, Capter7/E* . Prentice Hall.

Rossi, F., & Rosli, A. (2013). *Indicators of university-industry knowledge transfer performance and their implications for universities: Evidence from the UK's HE-BCI survey.* London, UK: CIMR Research Working Paper Series; Working Paper No. 13., Birkbeck University of London.

Sercan, D., & Turan, P. (2021). Lean management tools in aviation industry: New wine into old wineskins; Lean management tools in aviation industry: New wine into old wineskins. *International Journal of Aeronautics and Astronautics, 2 (3)*, 77-83.

Shingo, S. (1981). *A study of the Toyota Production System from an industrial engineering viewpoint.* Tokyo: Japan Management Association.

Sillero, P. J. (2013). The teaching-learning process of lean concepts. *11th Latin American and Caribbean Conference for Engineering and Technology (LACCEI'2013): "Innovation in Engineering, Technology and Education for Competitiveness and Prosperity, August 14-16, 2013.* Cancun, Mexico.

Soares, L., Steele, P., & Wayt, L. (2016). *Evolving higher education business models: Leading with data to deliver results.* Washington DC, USA: American Council o Education.

Sua´rez-Barrazaa, M. F., Smith, T., & Dahlgaard-Park, S. M. (2012). Lean service: A literature analysis and classification. *Total Quality Management, 23(4)*, 359–380.

Sunday, F. (2022, February 4). *Universities need state bailout to survive, Auditor General warns.* Retrieved from Standard Media: https://www.standardmedia.co.ke/education/article/2001436470/universities-need-state-bailout-to-survive-auditor-general-warns

Twidale, M., & Nichols, D. (2013). *Agile methods for agile universities: Re-imagining the creative university of the 21stcentury.* Besley USA: Sense Publishers.

Wamalwa, M. S., Onkware, K., & Musiega, D. (2014). Effects of lean manufacturing technology strategy implementation on factory time efficiency: A case study of Mumias Sugar Company Limited in Kakamega County, Kenya. *International Journal of Business and Management Invention, Vol.3,No. 5*, 1-10.

Wanzala, O. (2018, August 12). *UoN freezes hiring as low enrolment hits cash flow*. Retrieved October 28, 2018, from Daily Nation , Business Week: https://www.nation.co.ke › News › Education

Womack, J., & Jones, D. (1996). *Lean thinking.* New York, NY.: Simon & Schuster.

Womack, J., & Jones, D. (2003). *Lean thinking: Banish waste and create wealth in your corporation, Rev. edn.* New York; London: Free Press; Simon & Schuster.

Womack, J., Jones, D., & Roos, D. (1990). *The machine that changed the world.* New York.: Rawson Associates.

World Bank. (2019). *Improving higher education performance in Kenya: A Policy Report.* Washington D.C: World Bank.

Xiaocheng, W. (2010). Performance measurement in universities- Managerial perspective. Enschede, The Netherlands: Unpublished Thesis for the award of MBA in Finance, University of Twente.

Yamamoto, K., Milstead, M., & LIoyd, R. (2019). A Review of the development of lean manufacturing and related lean practices: The case of Toyota Production System and

managerial thinking. *International Management Review, 15(2),* 21-40.

Ziskovsky, B., & Ziskovsky, J. (2007). *Doing more with less – Going lean in educatiion; A White Paper on Process Improvement in Education.* Shoreview, Minnesota: Lean Education Enterprises, Inc.; (Available at www.leaneducation.com).