Waste identification and elimination in HEIs: the role of Lean thinking

Jacqueline Ann Douglas
Liverpool Business School, Liverpool John Moores University, Liverpool, UK

Jiju Antony
School of Management and Languages,Heriot-Watt University, Edinburgh, UK, and

Alexander Douglas
The Management University of Africa, Nairobi, Kenya

Abstract

Purpose – The purpose of this paper is to translate the eight wastes of Lean for Higher Education Institutions (HEIs), identify some examples of each waste and to propose appropriate Lean solutions to those wastes.

Design/methodology/approach – To identify wastes within HEIs a combination of observation and cause-and-effect analysis utilising brainstorming were employed using a convenience sample of HE academic staff.

Findings – Once all eight wastes were successfully translated for HEIs a range of examples were identified in both academic and support services, including excessive movement of people, over production of materials, excessive inventory and waste of human resources. Appropriate Lean solutions to the identified wastes include the use of 5S, point-of-use-storage, process mapping/value stream mapping and level scheduling.

Research limitations/implications – The cited examples come from a limited number of observationsin only a few HEIs. More valid and reliable data would come from a more extensive sample of HEIs.

Practical implications – In order to improve bottom-line performance in times of constrained resources HEIs can reduce waste and hence costs of poor quality by using Lean thinking and accessing, what Joseph Juran (1962) called, "The gold in the mine". This can be done without reducing the level of services.

Social implications – Particularly in a recession, HEIs need to show that they are using government funding (public money) in the most efficient and effective way possible. Lean thinking can help achieve both these objectives.

Originality/value – Previous papers on Lean thinking applied to HEIs have concentrated on individual processes such as curriculum design or student assessment. This paper takes a holistic view demonstrating how Lean thinking theories can be practically applied across both academic and administrative areas of HEI operations.

Keywords Lean thinking, Observation, Higher education, Waste

Introduction

Despite some well publicised setbacks, for example Her Majesty's Revenue and Customs (HRMC) (Neveling, 2007) the use of lean techniques is now commonplace across the breadth of the service sector, including financial services, transactional services and public services such as health and local government. Indeed health is the area of the public sector where there are the most reported uses of lean (Radnor and Bowden, 2008). The last large service sector bastion to succumb to this 'lean onslaught' is education generally and Higher Education (HE) particularly. However, are the principles and techniques of lean appropriate to Higher Education Institutions (HEIs)? Previous papers on Lean Thinking applied to HEIs have concentrated on individual processes such as course design (Emiliani, 2004), curriculum design (Dey, 2007) or student assessment (El-Sayed *et al.*, 2011). This paper takes a more holistic view by demonstrating how Lean Thinking theories can be applied across all areas of HEI operations.

What is Lean Thinking

Womack and Jones (1996, 2003) define Lean Thinking as "the endless transformation of waste into value from the customer's perspective". Lean is both a management philosophy and a methodology, utilising various tools and techniques, aimed at improving quality and reducing waste (Waterman and McCue, 2012). In order to do this management need to take a systems approach to how they view their organisations. These systems consist of processes that deliver outputs (products and services) to internal and external customers. Examination of these processes will allow them to identify which ones are appropriate for the application of lean tools (Radnor and Boaden, 2008). Lean is based on five core principles, based on the premise that organisations are made up of processes (Radnor and Bowden, 2008). These are:

- Specify value from the standpoint of the customer;

- Identify the value stream for each product and eliminate those steps that do not create value;

- Make the product flow smoothly and continuously down the value stream;

- Where continuous flow is not possible let customers pull value between all steps;

- Aim for a state of perfection by reducing the number of steps and the amount of time needed to serve the customer (Womack, 2002).

The HE Context

The last decade has witnessed a growth in the number of students entering HE in the UK. However, these increasing numbers coupled with a global recession have caused the UK Government to re-think how UK universities should be funded in England (Scotland and Wales have different funding arrangements). In 2012 publicly funded HE providers in England were allowed to charge students tuition fees of up to £9000 a year for a full-time course. This has created a more competitive environment within the sector. University Vice Chancellors are now also designated as Chief Executive Officers (CEOs) to reflect a more business orientation that includes income generation and commercial activity. Financial stability and sustainability are now viewed as requirements for survival. In order to increase operating margins and profits, HEIs have implemented initiatives to reduce or control costs (Comm and Mathaisel, 2005). One such strategy is the implementation of lean principles and practices. Lean can, *inter alia*, improve quality, simplify, accelerate and improve processes, increase customer satisfaction and reduce costs (Dey, 2007). Unfortunately some managers view the use of lean tools as a way to reduce headcount (Post and Slaughter, 2000) with LEAN being dubbed an acronym for Less Employees Are Needed. This misuse of Lean principles and associated negative connotations must be avoided if improvements are to be implemented quickly (Emiliani and Stec, 2004). Lean has its origins in the private sector (Barry *et al.,* 2001) generally and the manufacturing sector particularly. There has long been

a debate within the literature as to whether or not the two sectors are significantly different because the outcome would have major implications for the transference and applicability of models and initiatives between the two sectors. Edgett and Parkinson (1993) suggested that this debate began over fifty years ago when Regan (1963) attempted to classify services. He identified four characteristics that are now widely accepted as factors that distinguished manufactured goods from services, these are:

- Services are produced and consumed simultaneously – the customer has to be there to receive the service

- Services are perishable. they cannot be stored

- Services are intangible – they cannot be touched, tasted or seen;

- Services are variable – the service may be perceived to vary from customer to customer. They are difficult to standardise.

Having established the differentiating characteristics of services the next debate focused on whether or not all services were similar or if they could be grouped together based on their attributes. Dotchin and Oakland (1994) claimed that by classifying services by attributes it would show which services could rightly be compared and under what circumstances techniques and ideas used in one service could be transferred to another. Schmenner (1986) developed a classification system for services based on three attributes of services: labour intensity, interaction and customisation. He suggested four different groupings using a two-by-two matrix with a horizontal dimension which measured the degree of interaction and customisation (high or low) and a vertical dimension that measured labour intensity (high or low). The four groupings were:

- Service Shop – characterised by low labour intensity and high interaction and customisation;

- Professional services – characterised by high labour intensity and high interaction and customisation;

- Service factory – characterised by low labour intensity and low interaction and customisation;

- Mass service – characterised by high labour intensity and low interaction and customisation.

Higher education can be characterised as a mass service as HEIs are typically highly labour intensive and there is little opportunity for the "customer" (the student) to actively intervene to change the content of the service and there is very little customisation of the service – all students receive the same thing. Basically, students receive an undifferentiated service in a labour-intensive environment (Fitzsimmons and Fitzsimmons, 2006). Therefore HEIs can be differentiated from manufacturing firms and from other services organisations but does this preclude the successful use of lean initiatives? Womack *et al* (1990 p9) argued that "the fundamental ideas of lean production are universal – applicable anywhere by anyone". Time and experience have proven this to be the case with lean techniques being applied across manufacturing and a wide range of services.

Radnor *et al* (2006) found that lean is a suitable methodology for improving performance and embedding a continuous improvement culture in the public sector. However embedding such a culture is not easy. Antony *et al* (2012) have identified critical success factors for the implementation of lean in HEIs. These include *inter alia*, strategic and visionary leadership and organisational culture. Creating the right culture for Lean has been identified as a major challenge in HE (Antony *et al.*, 2012). HEIs are organised around departments and the implementation of process management techniques, particularly where processes cross departmental boundaries, may be resisted. As with Total Quality Management implementation previously, the issue of "students as customers" may also be viewed as threatening. This resistance of academic departments meant that TQM was focused on non-academic departments thus ignoring key processes (Mehralizadeh and Safaeemoghaddam,

2010). To-date in public healthcare most lean applications have been in non-patient contact areas (Radnor and Boaden, 2008). HE must avoid this. To be of use Lean has to be implemented in both academic and non-academic departments as both contain processes critical to delivering customer satisfaction.

Lean and HEIs' Performance Indicators

The performance of publicly funded HEIs in England is measured against a set of indicators developed by the Higher Education Funding Council for England (HEFCE). These indicators provide comparative data on the performance of HEIs in widening participation, student retention, learning and teaching outcomes, research outputs and employment of graduates and are about holding HEIs accountable for their use of public funds (Higher Education Statistics Agency (HESA), 2013)(available at www.hesa.ac.uk).

The other set of indicators that are important to HEIs are those used by various organisations such as The Complete University Guide (www.the completeuniversityguide.co.uk) to draw up league tables of university performance. These ranking tables use measures such as student satisfaction, entry standards, research assessment, staff student ratios, academic service spend (the expenditure per student on all academic services), facilities spend (the expenditure per student on staff and student facilities), good honours degree classification, graduate prospects and completion (The Complete University Guide, 2013). These league tables are available to all stakeholders in higher education, particularly those potential students (home based and international) making decisions on where to study.

Arguably, lean principles can positively impact on a number of these indicators. Reducing waste and improving the efficiency of service delivery has the potential to impact student satisfaction, staff student ratios (by making more funds available for recruitment) and both academic service and facilities spending. HEIs can channel any savings made to where they will have the most impact on performance indicators.

Therefore any lean initiative can be judged by the shift in budgeted costs to staff, students and facilities and away from costs associated with inefficiencies and waste management, for example poor processes and complaints handling. Improved efficiency will also lead to freeing up staff time and this can potentially impact on the quality of learning and teaching and research outputs.

Value and the Customer

Lean should be about delivering value as defined by the customer. This value judgement is based on their perception of the usefulness or necessity of a given service. However, defining the customer in the Public Sector generally and HE particularly has always been problematic. Normally this is the person who pays for and uses a product or service (Emiliani, 2004). Kollberg *et al* (2007) argue that in healthcare, for example, the patient may be viewed as the primary customer since it is patients that justify the existence of such services, but other customers include the patient's family, society in general and government that funds the service. In the case of HE in England is the student customer? Although charged up to £9000 for tuition these fees are not paid up front. The student is able to take out a loan to cover their cost and pay that back once they are working and earning above the repayment threshold of £21000 per year. So is the customer the Government who initially funds education, the student who is the primary recipient of the educational tuition service, future employees in industry or society at large (El-Sayed *et al.,* 2011). In other words there seems to be multiple stakeholders in the education process. However, following Kollberg *et al*'s (2007) argument about patients justifying the existence of healthcare services then it must follow that since students justify the existence of education services then they must be viewed as the primary customer. To complicate matters further customers can be 'internal' or 'external'. Many employees in HE deal with only internal customers. From a systems point of view HEIs can be viewed as a series of systems and processes. There is, for example, a

Financial System, an Administration System, an IT System, and a Facilities Management System to cite but a few. All these systems contain processes and it is the processes that deliver the outputs that should add value to internal and external customers if they in some way transform the service, if they are done right first time and if the customer recognises their value (Munro *et al.*, 2008). However, some processes perform functions that do not transform the service and the customer is not willing to pay for these activities. These are called non-value added activities or waste. Waste is the focus of this paper.

Waste

Lean is a methodology to simplify and streamline processes by identifying and eliminating waste (Wedgwood, 2007). Waste as defined by Womack and Jones (1996, 2003) is "any human activity that absorbs resources but creates no value". However, before waste can be removed it must be recognised and this is the biggest challenge for any service organisation (George, 2003). Once recognised its causes must be understood (Seddon and O'Donovan, 2009) and these addressed if it is to be permanently removed. For a university many processes cross functional and departmental boundaries. A consequence of this is many handovers and longer processes with more steps. The more steps and handovers there are the greater the likelihood of errors and subsequently waste.

The Lean movement has identified eight categories of waste (Duffy and Wong, 2013) or *muda* as the Japanese call it. These were originally identified for a manufacturing environment (Ohno, (1988). These generic wastes are:

- Excess motion – people or equipment walking or moving more than necessary to perform the process;

- Excess transportation – the movement of materials not required to perform the processing;

- Underutilised people – not using the full abilities of people/employees;

- Inventory – all parts, work-in-progress and finished goods not being processed;

- Defects – all work associated with identifying and correcting defects;

- Over production – production ahead of demand;

- Waiting – for the previous process step to deliver;

- Over processing – doing things that add no value for the customer.

Radnor *et al* (2006) categorised the eight wastes for services as:

- Delay;

- Duplication;

- Unnecessary Movement;

- Unclear Communication;

- Incorrect Inventory;

- Opportunity Lost;

- Errors;

- People.

However, Sarkar (2008) believed the eight wastes to be universally applicable and therefore did not require sector specific categorisation.

There have been a number of attempts at identifying waste in the public sector over the years. Waterman and McCue (2012) identified the following wastes in public procurement:

- Excessive amounts of guidance;

- Elongated timescales;

- Serial processing;

- Inefficient supplier engagement;

- Input based specifications;

- Risk aversion.

Kollberg *et al* (2007) reported examples of waste in healthcare as:

- Delays between the expected time and actual times for a visit;

- Delays between the expected time and actual time for an operation;

- Over capacity;

- Preparation time needed for a visit;

- Preparation time needed for an operation;

- Medical equipment downtime;

- Procedures to manage referrals;

- Transportation of patients;

- Booking procedures.

In their research into the Scottish Public Sector, Radnor *et al* (2006) found that some organisations used the generic wastes to identify types of waste whilst others used a more flexible approach. Identified wastes included:

- Rework

- Preparing unnecessary reports

- Working with badly designed IT systems

- Fire fighting

- Working from unreliable information

- Checking other people's work

- Too many meetings/working groups

- Progress chasing

- Doing things others have already done

- Obtaining authorisation

- Work not fit for purpose

- Dealing with failure demand

Regardless of the approach however, before HEIs can begin to eliminate wastes these eight generic wastes must be translated into terms that can be recognised by people working in them. This translation can be helped by using actual working examples of waste in HEI processes to illustrate them.

The aims of this paper are therefore:

i.   To translate the eight wastes of Lean for HEIs;

ii. To report on examples of such wastes observed or experienced in HEIs;

iii. To advance some potential Lean solutions to the identified HEIs' wastes.

The focus of this paper is operational rather than strategic issues within HEIs but it recognises that there is a need for Lean Thinking to be applied at the strategic levels of academic and support services to allow the design and operation of facilities waste free. This requires education and training.

Method

A convenience sample of 6 university academic staff was assembled with the aim of identifying waste in HEIs. The sample group had no previous knowledge of lean thinking or lean principles. However, as the group are directly related to the subject of study (HEIs) findings can be generalised to the wider population. Between them the group had over 75 years experience in HEIs having been employed at various universities as either full-time members of staff or as external examiners. Their task was a brainstorming task related to waste in HEIs. Brainstorming is a qualitative tool for generating ideas. All members of the sample group had previous experience of participating in brainstorming sessions. The group

had to generate examples of waste that they had either personally observed or experienced. Observation as a data collection methodology has been widely used in many branches of social science research (Arumugam *et al.*, 2012). Therefore the method used to identify examples of waste in HEIs is participant observation as espoused by the architects of the Toyota Production System (TPS), Shigeo Shingo and Taichi Ohno. The task lasted around 20 minutes. To aid the group and give their brainstorming session more structure a Cause-and-Effect diagram was displayed, visible to all participants, with the "Effects" box labelled "Waste in HEIs" and the main branches or bones labelled with the eight generic wastes. The facilitator described the eight wastes (Table 1, column a) and the group were given their translation for HEIs (Table 1, column b). The results of the brainstorming session are shown below (Table 1, column c). The brainstorming session was followed by a focus group discussion where members of the group swapped and confirmed more detailed examples of waste with each other. These examples are detailed below. Once the wastes had been identified the facilitator, knowledgeable in lean principles and tools and techniques, identified possible lean solutions that could eliminate the waste.

Results

Table 1 below shows each of the eight wastes (a), their translation for HE (b) and some HE examples of each waste (c).

Table 1: **Lean HEI: Eight Types of Waste with Examples**

Insert table here

Lean Solutions to the Eight Wastes

Once waste has been identified, a number of Lean tools and techniques can be used to remove it. Appropriate lean solutions to the identified wastes include the use of 5S, Point-Of-Use-Storage (POUS), Just-in-time production and delivery, process mapping / value stream mapping, standard operating procedures and level scheduling. These tools and

techniques can reduce waiting time, reduce unnecessary movement of people and materials, identify handovers and reduce inventory. The focus group identified a number of example processes where lean solutions could be used to reduce waste and speed up the processes.

Example 1: Photocopying Process. The photocopiers are stationed in a room near to staff offices on the second floor of the building. The paper is stored on the third floor in a storeroom. When the copier paper is finished a member of staff has to go to the third floor and collect a box of paper from the storeroom and carry it to the second floor photocopier room. This scenario can be repeated three or four times per day. The application of POUS can be used to reduce unnecessary movement of material and people and is applicable to both academic and administrative staff. This was achieved by locating a store cupboard next to the photocopiers, thereby eliminating the need for the (wasteful) movement of people and materials and furthermore speeding up the photocopying process.

Example 2: Assignment / Examination Mark Submission Process. Papers are marked by academics and then entered into an Excel spreadsheet. This spreadsheet is then sent to an administrator who takes these marks and logs them into the official university system. Once done the official version is emailed as a Pdf file to the academic who then checks the marks against the original excel spreadsheet. The administrator is informed of any transcription errors and amends the university master system accordingly. There are too many handovers and too much checking of other peoples' work. The more steps that there are in the process the more likelihood of errors. Clearly the academic should just log the marks directly into the university system.

Example 3: Funding Application Process. Academics seek funding for many things, usually associated with research, for example conference attendance to present a research paper. In many HEIs such applications entail the completion of a paper proforma that, in order to be approved, require multiple signatures at various managerial levels. Once all the signatures are

in place a research committee may have to meet to give final approval. This is a long and time-consuming process which could be made even longer if one of the required signatories is absent through holiday entitlement or sick leave. This process needs to be speeded up. Are multiple approvals necessary? Can the process be carried out electronically? The standard operating procedure needs changed. There are no internal standards of service and therefore no associated process or cycle times. A standard operating procedure inclusive of internal standards of service would provide a measurable performance standard.

Other examples cited where proforma needed to be completed and submitted through the multiple signatories process included, obtaining a carpark permit for new staff or a visitor, claiming of expenses, purchasing of simple items like stationery.

Conclusions and Implications

This paper set out to translate the eight wastes of lean for HEIs and provide some examples of each waste. These objectives have been achieved. HEIs are a collection of systems, subsystems and processes in both academic and administrative functions. These systems and processes are not as efficient and effective as they could be. They contain many forms of waste that are costly to both the university and its customers. Lean concepts need to be applied, initially to recognise waste in current processes and then to eliminate that waste thus allowing the realisation of "the gold in the mine" of reduced costs, improved performance and increased customer satisfaction. This will not be easy given the culture of HEIs but with education and training senior executives should recognise the value of lean at a strategic level and its potential impact at operations level.

Social implications

Lean has the potential to reduce the impact of government cuts, due to the continuing global recession, to publicly funded services such as health and education. HEIs are expected to shoulder their share of austerity measures and make each taxpayer's pound stretch that bit

farther. In order to do this in a way that such cuts do not adversely impact services to customers, wasteful practices must be identified and eliminated.

Future Research Agenda

To-date, in HE Lean has been mostly been applied in administration, finance, HR, Estates, Library and other support services. If lean is to avoid the fate of TQM it must also be applied to academic processes. There is a need to identify and eliminate waste in teaching related and research related processes as well as academic administration process. A comparison of performance across a range of measures (in both academic and administrative processes) between lean and non-lean HEIs would be a logical next step in researching the impact of lean principles on HEIs. Like six sigma the collection of factual evidence in the form of hard data on improved processes (time and cost) and reduction in waste (costs) will be required in order to convert those sceptics (academic and non-academic) unwilling to be convinced by anecdotal evidence as to the potential of lean across all areas of HEI operations.

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