A framework for implementing lean operations management in the higher education sector[1]

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Abstract

Purpose. This paper presents a framework for implementting of the technical and operational aspects of lean manufactuirng within the higher education sector based on research within and outwith the sector.

Methodology. Using a grounded theory approach 34 interviews were carried out with experts and pratitioners in implementing lean manufactuirng within higher education, public and manufactuirng sectors.

Findings. The findings show that within the technical and operational aspects is a need for good portfolio, programme and project management of implementation inititives within the higer education sector. The findings further identify key aspects of implementation to be, project selection and integration, tool selection and integration, adoption of lean prnciples and, the importance of a good measurement system.

Practical implications. The developed lean operations management framework offers a practical and unique approach to implementing lean manufacturing within the higher education sector.

Originality/value. This paper presents a number of contributions to knowledge including a protfolio, programme and project management approach to implementation, lessons learned from implementation initiatives and a framework representing new theory grounded in data.

Keywords

lean manufacturing; lean operations management; higher education

[1] This work is based on the PhD research work carried out by Michele Cano

1. Introduction

Lean Manufacturing (LM) is one manufacturing approach to improvement that companies adopt in order to achieve this elimination of waste and reduction in costs (Balzer *et al.*, 2015; Bicheno and Holweg, 2009; Douglas *et al.*, 2015; Liker, 2004; Novak, 2006; Santos *et al.*, 2006; Stone, 2012; Womack and Jones, 2003).

Similarly, within the Higher Eduation (HE) sector the ever-changing demands of society, students as the customers and funding cuts has led to Higher Education Institutions (HEIs) examining their operations with a view to doing more with less (Deem, 2008; Pitcher, 2013) and adopting a manufacturing philosophy such as LM has been shown to provide benefits that allow companies to do more with less.

It is also recognised that the implementation of LM can lead to substantial improvements and benefits, however it is also recognised that many attempts fail to achieve the possible benefits, with many initiatives falling away. This is evident for manufacturing and service companies with few achieving the full benefits that LM claims to effectuate (Bicheno and Holweg, 2009; Feld, 2001; Hobbs, 2004; Liker, 2004; Ortiz, 2008; Page, 2004; Santos *et al.*, 2006; Womack and Jones, 2003).

The principles of LM have been adopted by a number of public sector bodies, with perhaps the National Health Service (NHS) leading the way (Ballé and Regnièr, 2007; Cano *et al.*, 2012; Hines and Taylor, 2000).

In recent years, HEIs have embarked on the implementation of LM principles to assist in helping them face the current economic challenges (Balzer, 2010; Balzer *et al.*, 2015; Comm and Mathaisel, 2005a; Emiliani, 2012). Antony *et al.* (2012) and Svensson *et al.* (2015) advocate a hybrid approach of LM and Six Sigma (SS) using tools from both approaches to assist HEIs in improvement.

This paper, puts forward an approach which looks at the implementation of lean manufactuirng from an operations perspective.

2. LM and LM Implementation

LM is a term which was developed by Krafcik (1988) and was later termed "lean" in 1990s (Womack *et al.*, 1990). It is an approach which encourages flow through the elimination of waste (Bicheno and Holweg, 2009; Douglas *et al.*, 2015; Liker, 2004; Womack *et al.*, 1990; Womack and Jones, 2003). According to Askin & Goldberg (2002); Liker (2004); Ohno (1988), and Santos *et al.* (2006) there are seven types of waste in the system. These waste types can be summarised as overproduction, excess inventory, unnecessary transportation, defects, over processing, motion and waiting. Liker (2004) also includes 'unused employee creativity' as an eighth type of waste in the system.

By following the LM principles these wastes can arguably be reduced and eliminated realising greater efficiencies and a reduction in costs. LM principles include: specifying value, identifying the value stream, flow, customer pull and pursuit of excellence (Balzer, 2010; Hines *et al.*, 2004; Womack and Jones, 2003).

Kochan *et al.* (1997, p.303) are of the view that '*lean production was a universally applicable system and that those firms that did not adopt it would sooner or later be squeezed out of the market'*. Novak (2006, p.150) supports the view of LM being universally applicable when he argues that *'lean techniques can, and have been, used successfully beyond the shop floor'.* Stone (2012b) also recognises that *'lean thinking has evolved from the manufacturing environment to be applicable throughout an organisation and industries outside manufacturing'*

While it is recognised that the implementation of LM principles can lead to substantial improvements and benefits, including waste minimisation, reduced costs, better product flows, improved efficiencies and increased customer and employee satisfaction, it is also recognised that many attempts fail to achieve the possible benefits, with many initiatives falling away. This is evident for manufacturing and service companies with few achieving the full benefits that LM claims to bring about (Bicheno and Holweg, 2009; Feld, 2001; Liker, 2004; Ortiz, 2008; Page, 2004; Santos *et al.*, 2006; Womack and Jones, 2003).

However, it also recognised that there is no one approach or framework to assist companies with the implementation of LM (Bicheno and Holweg, 2009). Hobbs (2004) further argues that the implementation of LM in many companies is inadequate, thereby resulting in some level of frustration due to the fact that promised benefits of the LM implementation initiatives are often not realised. Liker (2004) recognises that few companies adopt the LM philosophy fully and fail to achieve anything beyond process improvement. In support of this he moots that LM consists of a four stage model which includes a long term philosophy; processes; people and partnerships; and continuous improvement with each of these four elements required in order to gain real benefits.

3. LM in Higher Education

In view of the seemingly challenging approach to implementing LM and getting it right the first time, the question arises as to whether LM is appropriate for HEIs.

Within the HE sector, attempts to apply quality management models from industry have had limited success (Srikanthan and Dalrymple, 2002). In support of this, Srikanthan and Dalrymple point out that there are two separate functions of service and education and opine that a clear distinction has to be made between the processes associated with the two types of functions. They further argue that the failure to recognise the distinct difference of these functions leads to incompatibility within implementation approaches.

It is also important to note that there are several approaches to continuous improvement but not limited to LM including, SS, Lean Six Sigma (LSS), Total Quality Management (TQM) and Theory of Constraints (Antony *et al.*, 2012; Bendell, 2006; Dahlgaard and Dahlgaard, 2006) which could be used in order to make improvement either in manufacturing, retail or service industries. The challenge lies in the selection and implementation of these methods.

Furthermore, although there is no shortage of literature on LM, there exists very little literature in the consideration of LM implementation in the HE sector. Balzer (2010) analyses the implementation of LM in HE administration with Emiliani, (2012) advocating LM in teaching within HEIs. Comm and Mathaisel (2003; 2005a and 2005b) and Doman (2011) present case study projects within the administrative processes. Isaksson *et al.* (2013) provide a reflective discussion on how LM might be applied to academic rather than administrative processes. More recently, articles on success factors have started to emerge (Balzer *et al.*, 2015; Waterbury, 2015).

This is a developing area which is currently under populated in terms of literature and a thorough investigation into the practice and philosophy is required.

4. Methodology

Using a grounded theory approach, 34 interviews were carried out with practitioners and experts involved in the implementation of lean manufacturing. Of the 34 interviews, 18 were based in the manufacturing sector (interviews M1-18) to determine the best practices and

lessons learned. Of the remaining interviews, 4 were from the public sector the (interviews PS 1-4), 5 were with leading consultants and academics (interviews E1-5) and 7 were from within the HE sector (interviews HE 1-7). Based on Strauss and Corbin (1998) grounded theory method, the interviews were selected based on theoretical sampling. Each of the interview transcripts underwent a process of open, axial and selective coding to determine the main codes, concepts and categories and the relationship between them.

5. Findings

The findings identified 27 key concepts, however this paper presents the concepts associated with the technical operations side of LM. The concepts associated with lean operations management include: Initiative, Approach, Flexibility, Use of tools (selection), Measurement, Risk and impact analysis, Stakeholder Analysis, Project Selection and Benefits Realisation. These were axially coded to form the key category of Lean Operations Management as it included the operational requirements necessary for the implementation of LM but recognised management and government aspects to the operations.

LM was identified through all the interview phases as the most favoured approach. This was primarily because it was perceived as less technical than SS. However, with the understanding from the majority of interviewees that LM was a collection of tools, there is a question about whether or not LM is actually being implemented in its entirety. This raises the further question of whether or not LM is really being implemented or is it just certain tools that are perceived to constitute a LM initiative. The findings also showed that although LM is the favoured approach, the initiatives available to management for improvement purposes are converging. In manufacturing the mature high volume organisations use an evolved LSS approach. This is evolved rather than as part of a prescribed approach, due to the implementation of both LM and SS separately. However, the general consensus from the other three phases of interviews was that SS was too *'sophisticated'* or *'too technical'* for higher education and public sector organisations. Despite this view of SS, there was a definite use of basic SS tools in the public and HE sectors. These included tools such as the project charter and SS problem solving tools. This raises the question of 'does it matter which initiative is used if the outcome is the desired one?' Rebranding of an initiative to suit the organisation was suggested however, the danger is that a rebranding signifies an approach that is not structured and rigorous enough to reap real benefits and to involve a culture change. As a result, it becomes an ad-hoc approach with pockets of implementation focussed on cost savings and not on creating value.

Whether generated initially by consultants, or emerging internally, there appeared to be a bottom up approach and a top down approach to implementation. The bottom up approach involved suggestions for projects but there was a definite danger and indication that this approach was ad-hoc throughout the interviews. The top down approach involved more of a review of services, areas or processes which would lead to the identification of projects. However, as seen from the HE interviews, there was a potential misunderstanding of what was a LM project, what was cost savings and what was a general system or technology improvement. Therefore, there needs to be a clear understanding for higher education as to what constitutes the university change portfolio. The change portfolio would include programmes for change, not necessarily related to the LM initiative, but if LM was seen as a programme for change then this could be included and better governed to ensure that projects selected were in-line with the university portfolio and not just on an ad-hoc basis. Seeing the LM initiative as part of the portfolio would allow for governance and structure. Project selection could then be more focussed on outcomes, benefits realisation, risk and impacts as

well as employee 'readiness' for change. The problem of capturing success would also be diminished through good programme management. Project selection could then be based at the portfolio level and programme level, giving LM the high profile and necessary management commitment as well as resources and budgetary requirements. The willingness of the team to undertake the project was a factor raised by HE1 in project selection. If the team is not ready for a project or change then additional work needs to be carried out in creating that buy-in and readiness for change, through determining the reason for the unwillingness and by providing appropriate training and communication.

Project selection should not be to the detriment of trying to encourage ideas for continuous improvement from the bottom up, but rather provide a framework for ensuring benefits realisation from the individual projects and furthermore eliminating the negative competition between project teams identified by HE 2. Projects which do not reap benefits, whether in value or cost, or projects that might potentially save in one area but have a negative impact on another area, could be identified and decisions then made as to whether or not to resource the projects.

Projects in the HE and the public sectors, experienced failure through a lack of understanding of the impacts on non-direct stakeholders or other departments. Good project management could have prevented this through stakeholder analysis, impact analysis and risk assessment at the outset. Stakeholder analysis and inclusion in projects must be carried out at the project level, to ensure barriers to change are dealt with through communication. This may involve early intervention by management, but if not carried out could lead to failure of the project.

It was also found from manufacturing that reviewing one product from beginning to end was a '*huge project'* M16 but it did highlight waste and improvement possibilities and projects therein. However, the HE interviews indicated a reluctance and potential difficulties in looking at the student journey. Why is there a reluctance? Is it due to the number of stakeholders, the lack of clearly designed and standard processes, or the bureaucracy as referred to in the HE and expert interviews? It is a huge undertaking to review the student journey from beginning to end which would require management commitment, employee buy-in, good change management practices and good project management but it should not necessarily be shied from.

As part of a portfolio and programme management, the student journey and service reviews and reviews of processes which cut across organisational boundaries, would be facilitated but only as part of a change programme if re-engineering or restructuring was the outcome. Leadership commitment to this would be vital as this would involve radical change and impacts on current structures and processes. Programme management would assist in identifying projects as part of the programme of LM implementation, allowing for the bottom up approach as well as providing the governance and structure for a top down approach. The experts advised starting with process reviews, either using 7 wastes analysis and VSM, or process mapping. This was evidenced through the public sector interviews and higher education. Manufacturing interviews also supported a project approach, where projects could come from the bottom up, because of a culture of continuous improvement. However, wider reviews of products, services and functions were driven more top down than bottom up. As previously discussed, the issue surrounding these approaches, particularly the bottom up approach, is capturing success and effective use of staff time on projects which give the best gains. It is also very dependent on the culture within the organisation which could be attributed to the failure of a bottom up approach within one HEI as identified by interviews HE 4-7.

The setting up project teams with the right people, facilitated by a dedicated team of highly trained and motivated natural problem solvers was also important for the initiative.

Programme Management would allow for both bottom up projects, but in a less ad-hoc manner, through selection and management of projects integrated into an overall programme sitting within the HEI portfolio of change.

Project charters are being used which scope projects from the start, but not as part of a programme. The outcomes of the projects however, could be captured in terms of benefits realisation at the programme level. Benefits realisation was identified as the '*sum of the outcomes'* by the public sector interviewee PS1. Benefits were seen to include staff, students, patient and customer satisfaction, releasing of staff time, cost savings, and a better culture for continuous improvement. It was also found from the public sector and higher education sector interviews that projects which focussed on adding value to the student/customer/patient were more successful than those based on cutting costs, although cost savings often resulted. The improvement of flow whether of patients, students, products or information was identified as an important operational aspect which could only be achieved through having value adding activities and eliminate non-value adding activities. The use of tools to assist in the identification of waste and barriers to flow, was considered to be important in creating value, as determined in all phases of interviews, with the use of tools generally emerging as a strong code. There was recognition that not all tools suitable for manufacturing would be suitable for the HE sector; however, in some circumstances the tools were in ways in which people could relate them to their own environment and could create language and terminology around them. Specific LM tools for manufacturing which were found to work very well in public sector and HE organisations included Rapid Improvement Events or kaizen events, Value Stream Mapping (VSM), process mapping, 7 wastes analysis and visual boards. The sustainability of visual boards was raised by public sector interviewee PS3 and precipitated the issue of their maintenance and provided insight that should an HEI use visual boards the maintenance of them has to be scheduled into staff duties. It was also recognised that using tools such as VSM had the added advantage of engaging staff in the process.

Tools for different aspects of the implementation were used and fell into three types: diagnostics, analysis and solution generation tools. The findings also show that the selection of tools should be based on project needs and a suite of tools should be available which are not solely LM tools. The tool selection also relates back to the levels of training. There is the danger that the same tools are being applied because those are the tools that the teams have been trained on and are familiar with or those are the ones the consultant recommends. With different levels of training more sophisticated tools could be included and applied. The selection of tools also ties in with the flexibility of approach. The interviews highlighted that consultants generally have a prescribed approach which does not necessarily suit a particular project. Flexibility seemed to emerge as key for the non-manufacturing organisation. This should come within a framework however, with an overarching structure, and the selection of tools to be used in the project should be based on a suite, rather than a few. However, what must be avoided is that the project is seen from purely a technical stance, rather than understanding the people influence. A focus on tools could lead to a more technical approach which would be detrimental to the project, through a loss of focus on the objective of creating value, as identified by HE3. Lessons learned for higher education in implementing LM from the public sector and expert interviews were to keep things simple and visible, and use the tools to untangle complex processes.

Measurement was also seen as very important within the implementation of an initiative, through identifying and selecting projects to capturing and measuring them. It was recognised; however, that quantifying the non-tangible benefits is challenging. In scoping out a project the outcomes therefore should identify the benefits in a measurable way and improving customer satisfaction would not be considered a suitable outcome. How this is

broken down into quantifiable outcomes should be presented in project proposals and is an important point for higher education.

The role of Key Performance Indicators (KPIs) in measuring the success of a LM initiative came across strongly in the manufacturing sector as did setting targets. There was a challenge to this by two manufacturing interviewees (M1 and M2) who felt that the LM initiative was lost as the drive seemed to be more on achieving targets and KPIs. On the other hand, expert interviewee E4 recognised that one of the reasons for the success of implementing a LM initiative in manufacturing was because of the focus on KPIs and target setting. A lesson learned from the manufacturing sector was to deploy KPIs to the project level. However, it was raised by E5 that measurements are necessary in the short term and it has been established that LM should be long term to have the necessary effect of culture change. KPIs and targets, whilst necessary should be seen to be achievable and realistic.

6. Literature based on key concepts determined by findings for lean operations management

According to Piercy and Rich (2015) the importance of operations management is critical to organisational performance and sustainability and within the operations function Hines and Lethbridge (2008) suggest that the technical or operations side concerns the processes and the tools and techniques.

On the technical side, literature focuses on the implementation of the principles of LM Womack and Jones (2003); the TPS (Liker, 2004; Ohno, 1988); and the elimination of waste along with the tools used to assist in implementation (Balzer, 2010; Bicheno and Holweg, 2009; Comm and Mathaisel, 2005b; Liker, 2004; Nicholas, 1998; Ohno, 1988; Page, 2004; Santos *et al*., 2006; Womack *et al.*, 1990; Womack and Jones, 2003; Womack and Jones, 2005).

6.1 The principles of lean manufacturing in lean operations management

According to Womack and Jones (2003) the first two steps are associated with the first two principles: to determine value in the eyes of the customer; and to identify the value stream. They define the value stream as '*the set of all specific actions required to bring a specific product through the three critical management tasks of any business: the problem solving task running from concept through detailed design and engineering to product launch, the information management task running from order taking through detailed schedule to delivery, and the physical transformation task proceeding from raw materials to a finished product in the hands of the customer* (Womack and Jones, 2003, p. 19). Their recommendation is that after defining value is then to identify the entire value stream for each product which will highlight the muda or waste within the value stream. It can then be said that this waste is the antithesis or converse to value and includes all non-value adding activities within the organisation (Bicheno and Holweg, 2009; Liker, 2004; Ohno, 1988). Bicheno and Holweg (2009) caution that reducing waste is not the same as reducing cost and Liker (2004) recognises that there are some non-value added activities which are required such as inspections.

According to Page (2004, p.1) '*waste removal is lean'* and similarly Santos *et al.* (2006, p.8) describe '*lean is the systematic elimination of waste'.* This is disputed by Bicheno and Holweg (2009, p. 20) who suggest that waste is linked to LM recognising that the ratio of value added to non-value added can be improved in two ways '*by preventing and reducing waste, but also going after value enhancement'.*

Balzer (2010) and Douglas *et al.* (2015) recognise that there exists a number of ways of categorising the wastes for public services and office environments have evolved from Ohno's original 7 wastes. However, Douglas *et al.* (2015, p. 976) argue that *'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'.* Balzer (2010) further argues that this is necesary to increase value and improve flow within the HEI. Liker (2004, p.87) agrees with this and states '*a good place for any company to begin the journey to lean is to create continuous flow wherever applicable in its core manufacturing and service processes'.* Womack and Jones (2003) also specify flow as their third principle and eliminating non-value activities or waste within these processes is a technique which can help to have continuous flow within processes containing value added steps (Balzer, 2010; Bicheno and Holweg, 2009; Liker, 2004; Womack and Jones, 2004). However, Liker (2004) cautions that while creating continuous flow through the elimination of waste within core processes, many companies get stuck at this stage and LM becomes little more than process improvements through waste elimination.

Tied in closely with the concept of flow is the fourth principle advocated by Womack and Jones' (2003) which is the concept of 'pull'. The concept of pull is difficult for people to grasp (Novak, 2006, Seddon and Caulkin, 2007). Bicheno and Holweg (2009); Novak (2006) and Santos *et al.* (2006) describe the difference between a traditional or conventional push system and the pull system required by Just in Time (JIT) and LM. The pull system is said to be the core of JIT manufacturing, one of the pillars of the TPS (Liker, 2004; Ohno, 1988; Santos *et al,*.2006; Womack *et al.*, 2007) and is described by Liker (2004, p.24) as meaning that '*the preceding process must always do what the subsequent process says'.* Womack *et al.* (2007, p.294) argue that JIT is Toyota's pull system '*Ohno's production system is properly called just-in-time (JIT) or "the right part at the right time in the right amount" (More recently the term most commonly applied is the "pull" system'.*

Novak (2006) explain a push system as producing products based on a combination of sales forecast and customer orders, therefore, inventory is produced in expectation of future customer orders, resulting in high inventory levels. They describe the pull system as being in direct contrast to the pull system which can be described as making fewer products at a time and making to actual customer demand. Similarly, Santos *et al.* (2006) describe a push system as production orders flow from raw materials to finished goods compared to a pull system where orders flow from finished goods to raw materials. Womack and Jones (2003, p.67) state that '*pull in its simplest terms means that no one upstream should produce a good or service until the customer downstream asks for it'.* They recognise, however, that following this in practice is actually more complicated. Seddon and Caulkin (2007) also recognise this difficulty and argue that the concept of pull requires a change in mind set of the leaders of the organisation, taking the argument back to the importance of developing a deep understanding of LM and the principles therein.

Interestingly, there is a major void in literature regarding the pull system in association with higher education. Comm and Mathaisel (2005b, p.235) recommend that HEIs embarking on a LM initiative should '*apply Womack's five lean principles'* as does Waterbury (2015) yet neither explain how this can apply to the fourth principle of 'pull'. Similarly, Balzer (2010) suggests that in his principles, flow is achieved with more pull from the beneficiaries than push from the providers. Womack and Jones (2003) however argue that flow in itself is not enough, and once flow is mastered, they advise '*next you need to learn to pull'.*

The literature on LM within HE focuses mainly on process reviews and the elimination of waste to improve flow, for example, Comm and Mathaisel (2003; 2005b); Doman (2011); and Balzer *et al.* (2015). Only Balzer (2010) suggests that university processes produce services or goods according to a planned schedule based on projected not actual demand or when it is

convenient for employees not beneficiaries. He argues that this is a push system and which in his view is '*antithetical flow to pure flow'* (Balzer, 2010, p.211) and, therefore, advocates the implementation of a pull system. This lack of attention to the pull system goes back to Liker's (2004) caution that most organisations get stuck at the process stage of LM implementation.

Furthermore, the JIT system which is recognised as a pull system (Womack *et al.,* 2007) has been successfully applied to service organisations (Canel *et al.,* 2000; Jarrett, 2006; Kollberg *et al.,* 2006), although Duclos *et al.* (1995) recognise that this application is not widespread and literature based on JIT in services is sparse. Only Eriksen (1995, p.27) suggested the benefits of JIT and TQM for the HE sector which in his opinion is moving from an elite to a mass higher education system; *'The application of the concepts of total quality management and just-in-time inventory systems can provide an integrated and internally consistent philosophy of management and leadership in higher education. Fundamental to these concepts are flexibility, standardization, and simplicity in design'*

The final principle is to pursue perfection which Womack and Jones (2003) suggest comes from mastery of the first four principles and policy deployment. They argue that rather than undertaking many projects without direction, the idea is for management to select a few projects to achieve the goals. The selection of projects has been raised as a critical factor in the success of a LM initiative with poor selection of projects causing potential failure (Antony, 2007; Balzer *et al.,* 2105; Radnor and Osborne, 2013). Balzer *et al.* (2015, p.930) recognise that LM must be core to the strategy of the organisation and argues that *'lean must guide strategy'* and, therefore, '*choice of LHE initiatives must align with organizational strategy'.* Liker (2004) while recognising the importance of strategy deployment for LM, also suggests that the product journey be reviewed which then supports the joint top down and bottom up approach. However, from the findings there seemed to be no real focus for the selection and governance of projects which stemmed from a bottom up and top down approach. The findings suggested a need for a portfolio, programme and project management approach to LM implementation, and while not presented in literature in this way, there was a definite need for viewing LM implementation in a holistic way (Bicheno and Holweg, 2009; Liker, 2004; Naslund, 2008; Radnor and Osborne, 2013; Seddon *et al.,* 2011; Seddon and Caulkin, 2007; Svensson *et al*., 2015). The authors propose the a portfolio, programme an project management solution to the need for implementing LM in an holistic way.

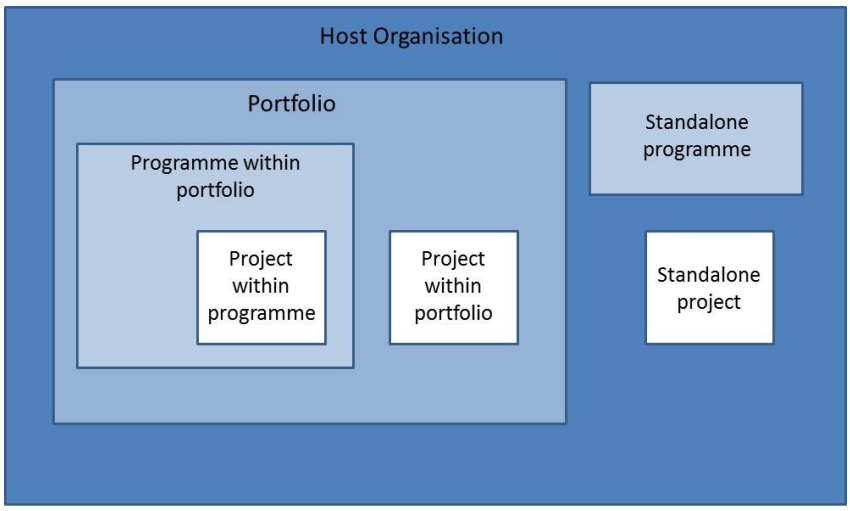
6.2 Portfolio, Programme and Project Management

According to the APM Body of Knowledge (BoK) (2012, p.2), '*Project, programme and portfolio (P3) management is concerned with managing discrete packages of work to achieve objectives'.* Within the context of P3 management consideration has to be given to the governance and the setting, where the governance deals with the procedural and cultural aspects influencing the outcomes and setting is to do with the organisational factors which are out with the boundaries of the project (APM BoK, 2012). Within the APM BoK (2012, p.2), the following diagram (Figure 3.2) presents diagrammatically the context for P3 management.

The APM Body of Knowledge (2012 p.16) describes Portfolio management as '*Portfolio management is the selection, prioritisation and control of an organisation's projects and programmes in line with its strategic objectives and capacity to deliver. The goal is to balance change initiatives and business-as-usual while optimising return on investment'.* Portfolio management however, is quite distinct from Programme management (Blomquist and Müller, 2006; Lycett *et al.,* 2004; Nieto-Rodriguez, 2014). Programme management while connected and related to portfolio management is seen as the integration and management of related projects to realise benefits (Thiry, 2002; Lycett *et al.,* 2004) or as a programme linked with organisational change (APM BoK, 2012; Pellegrinelli, 1997; Thiry,

2002). The APM BoK (2012, p. 14) define Programme Management as the '*coordinated management of projects and change Management activities to achieve beneficial change'*.

Figure 1: Context of P3 Management



Source APM Body of Knowledge, 2012, 6th Edition

Moran (2015 p.103) further adds that the function of programme management is to '*encompass governance, oversight for processes and methodologies (including their continual improvement and optimisation) as well as provide support.* Pellegrinelli (1997, p.142) however, makes an important observation that programmes, unlike projects, '*do not necessarily have a single clearly defined deliverable'* and adds that programmes create value by improving the management of projects that were previously in isolation. Thiry (2002) however, argues that while this is the case, the use of Value Management (VM) as a problem identification and solving methodology as a technique within the programme management can be utilised. Pellegrinelli (1997) further argues that Risk analysis and management techniques should be carried out at the programme level to as well as project level to address wider issues. He further advocates the importance of measurement in tracking project performance. Thiry (2002, p.225) recognises the need for measurement and tracking but also advocates the need for programme appraisal to '*reassess the programme's critical success factors on a regular basis'.*

For LM it has already been identified that project selection is a critical factor in the success of an initiative (Antony, 2007; Balzer *et al.* 2015; Radnor *et al*., 2006; Radnor and Osborne, 2013), under portfolio management, selection of projects is a key factor and according to Nieto-Rodriguez (2014, p.31) recognises that a '*company-wide process must be applied consistently'.* He suggests that every proposed idea for a project requires a business case some common selection criteria might be: return on investment, payback period, strategic alignment, risk, interdependencies and competency to deliver. However, for LM selection factors might also be the potential to add value and benefits for the customer. The benefits of P3 approach include realisation of project and programme benefits and the creation of value; more efficient uses of resources; and reduced costs (APM Bok, 2012).

To distinguish projects from programmes, project management is defined as '*the application of processes, methods, knowledge, skills and experience to achieve the project objectives'* APM BoK (2012, p.12). P3 management would appear to offer the necessary requirements for governance, project prioritising; management and change associated with LM implementation projects. Within the context of LM from the findings and literature it was

seen that projects were often selected in an *ad hoc* basis and were often autonomous with a difficulty in capturing success and measuring improvements. P3 management would then seem as an appropriate management method for realising and capturing the benefits that a LM programme can offer (APM Bok, 2012; Cano *et al*., 2015; Pellegrinelli, 1997).

6.3 Tools for LM and continuous improvement

The case for seeing LM as a philosophy and viewed holistically rather than a collection of tools has been presented in previous sections. Seddon and Caulkin (2007) while recognising the use of tools, argue that the tools are the least important part of the system. Seddon *et al.* (2011) further argue that the tools were developed in Toyota to deal with particular problems and, therefore, question their suitability on transfer to other sectors.

However, to achieve the five principles as advocated by Womack and Jones (2003), tools exist and many studies and implementation efforts focus on the use of tools as recognised by Piercy and Rich (2015); Bicheno and Holweg (2009); Thomas *et al.* (2015). The tools and techniques as part of the LM suite are considered to be 5S; Total Preventive Maintenance (TPM); Visual Stream Mapping; kanban; one-piece flow; single-minute exchange of dies (SMED); root cause analysis and 5 why method; and standardisation (Bicheno and Holweg 2009; Santos *et al.* 2006; Nicholas 1998; Ohno 1998; Novak 2006; and Page 2004). It is recognised that these tools have originated from manufacturing and within the context of the public sector and higher education the most popular tools are value stream mapping used to identify waste within the system (Balzer, 2010; Radnor *et al*., 2006) and process mapping (Doman 2011). This is in contradiction to Antony (2014) who at that time, felt while process models and flow charts were widely used in the manufacturing sector, they were not commonly used in service organisation. Rapid Improvement Events (REIs) or Kaizen Blitzes, emerged as popular tools in the public sector and higher education (Radnor *et al.* 2006). The limited use of tools within public sector organisations may be a result of a lack of understanding of the value and applicability of the tools (Radnor *et al.* 2006). However, Radnor *et al.* (2006, p. 2) suggest that some of the tools may need to be adapted to deal with the added flexibility required by service processes; '*some of the tools need to be adapted to cope with the need for greater process flexibility that are found in the public sector to meet the needs of the customer'.* Balzer *et al.* (2015) and Radnor *et al.* (2006), also recognise that to achieve full implementation a broad range of tools must be used with Balzer (2010) suggesting the use of problem solving using the Plan Do Check Action (PDCA) cycle. Radnor and Osborne (2013) also recommend the use of problems solving tools and citing Radnor (2010) classify them as tools for assessing the problem, improvement and monitoring.

6.4 Measurement within the LM environment

Within the management of programmes, tracking of individual project performance is seen as critical (Nieto-Rodriguez 2014). The literature surrounding LM, supports the need for measurement and according to Novak (2006 p. 261) '*performance measures, or metrics are an important tool that should be utilised in every organisation'.* Where the aim of performance measurement is to provide feedback to assist with decision making. Similar to the literature on project management (Pellegrinelli 1997; Lycett *et al.* 2004; Thiry 2002), Antony (2014) argues that all goals should be aligned with the corporate goals. Bhasin and Burcher (2006, p.58) support this and argue for lean leadership at all levels observed by the number of LM metrics at all levels. Novak (2006) recommends identifying the critical success factors and develop measures for those factors which can help in assessing the progress towards organisational goals.

Novak (2006) however, warns of the dangers of individual or worker performance measures and questions the real purpose of them other than for punishment. Bicheno and

Holweg (2009) support this argument and stating that performance measures drive behaviour and that misaligned measures will result in resistance and potentially counter-productive behaviour. This was evidenced by Radnor (2010, p.420) in her research findings '*In terms of continuous improvement from the interviews it became apparent that whilst attention has been paid to increasing productivity and the detection and prevention of errors, the focus on customer needs and staff motivation was sometimes lost by the pressure to achieve targets. Some sites did not achieve all their targets and some targets were viewed as unachievable'.* This is exactly as Liker (2004) warned when he argued that metric driven management takes the focus away from the customer and building a learning organisation. He recognises that metrics are often used as a tool for short-term cost control and advocates instead the elimination of non-lean metrics such as labour productivity in favour of value stream metrics such as lead time and inventory. Bicheno and Holweg (2009) also made an important observation that short term measures will lead to short term behaviours. Nicholas (1998); Bicheno and Holweg (2009); Seddon *et al.* (2011) and Liker (2004) attribute the cause of short term metrics to traditional accounting systems and emphasis on financial criteria (1998). Similarly, Ortiz (2008) argues for the need to improve shop floor metrics and Key Performance Indicators (KPIs) which he believes will produce better financial outcomes for the organisation. Antony (2014) however recognises that measurement is an important factor in manufacturing, and area in which the public sector lags behind. Within a university, Balzer (2010) recommends that the LM team develops direct, specific and focussed measures which must represent the beneficiary identified values and expectations. Balzer (2010) suggests that metrics can be related to: time required by the process; the number of steps in the process; adequacy of resources for the process; the quality of the process; outcomes of the process; the cost of the process; and subjective evaluations of the process. Balzer *et al.* (2015) however suggests that new processes should be built with metrics which reflect the beneficiary expectation. The research findings from Comm and Mathaisel (2005b, p.234) highlighted that although some HEIs had metrics tied to goals, most had '*difficulty pointing to anything more than traditional measures and building internal financial controls'.* Their findings further suggested that participants would welcome standardisation of metrics across different faculties and schools. Arguably the traditional measures employed by different sectors do not support a LM implementation programme and, therefore, new measures aligned with goals need to be developed. It can also be argued that traditional performance measures such as productivity should be avoided in the LM programme.

7. Comparison with findings on lean operations management

Within the operations management are of LM the literature surrounding the five principles set out by Womack and Jones (2003) was investigated. Identification and categorising of waste was found to be a popular tool in improving processes for eliminating non-added value. Literature showed that waste needed to be categorised but not necessarily as set out by Ohno (1988). Literature also cautioned against getting stuck in the process improvement part of LM implementation rather than looking at it as a holistic programme. The findings evidenced that most LM implementation programmes were barely more than process reviews concentrating on the first three principles of value, the value stream and flow. A gap within literature and can also be concluded from the findings that the fourth principle of 'pull' is not being applied within the higher education sector. In terms of an approach for the implementation of LM and the selection of projects, literature and findings both showed the need for a combined bottom up and top down approach. The findings showed a reluctance within the HE sector to review the student journey; however, are students considered to be a customer or a product of the

education system? Regardless this journey does need to be viewed in terms of the LM principles of value, value stream, flow, pull and perfection.

From literature and findings project selection and governance was also seen as important. The findings demonstrated that there was an *ad hoc*. approach to project selection and governance, particularly within the higher education sector. Identification of what is a LM project and what constitutes cost savings and normal business improvements or enhancements need to be established was highlighted in literature but very strongly from the analysis of the primary data. The authors propose that good Portfolio, Programme and Project Management is required in LM implementation which will provide governance; assist in project selection; impact and risk assessment; stakeholder analysis; measuring and capturing success; and will eliminate the confusion with other cost cutting and change projects and include the LM programme as part of the HEI portfolio of change projects.

The literature examined the P3s as in terms of suitability for a LM implementation programme and offers the possible solution to the implementation problems already discusses such as lack of governance, poor project selection, not looking beyond process improvements to facilitating culture change.

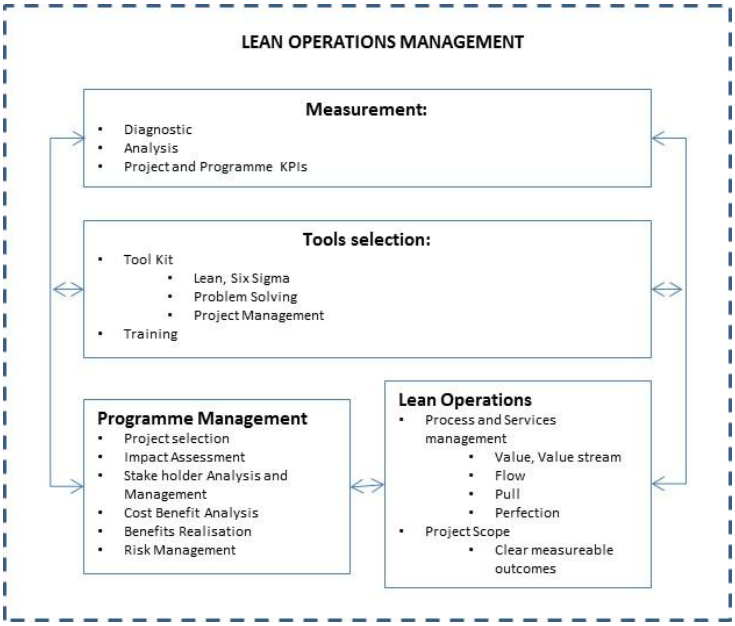
Findings also showed that projects needed to be properly scoped with clear measureable objectives. Measurements were contentious and literature argued that measurements needed to be LM related and not productivity or financial related. The danger of productivity measures was highlighted in the interviews through the negative effect of non-lean targets such as staff student rations. Findings also showed that projects which focused on improving value to the customer seemed to have a better success with better benefits realisation than projects focused on cost savings. The literature fully supported this proposition but also highlighted the need for deployment of LM metrics from the corporate level. The contribution to knowledge however is, for the higher education sector, project KPIs need to be deployed from the corporate strategy but need to focus on LM metrics rather than financial or productivity metrics.

Finally, the use of LM tools within the higher education sector is shown to be limited from both literature and findings, with the findings showing that there is more of a convergence of SS and LM tools. The most popular tools for use within HEIs seem to be value stream mapping and process mapping with some use of kaizen blitz or rapid improvement events. However, the sector may be missing out on the potential from other LM tools. Therefore, the findings suggest that it is better to train people in a range of tools allowing them to select the most appropriate for the need of the project. These tools should include LM; SS; problem solving; and project management tools. Therefore, it is proposed that selection and use of tools should not be restricted only to LM tools but project teams need to be aware of and trained in the suite of tools available.

One further aspect within the lean operations management section from findings was the flexibility in approach required within the public and higher education sector. The literature supported this indirectly through recognition of the need to adapt language and tools. However, within the suite of tools for the proposed framework, flexibility is built in through the selection of tools, this mix of a top down and bottom up approach and by not prescribing the step by step approach which would not consider cultural factors within the HEI.

A framework for lean operations management considering the findings and litertaure is shown in Figure 2.

Figure 2: Framework for lean operations management



8. Conclusions

This paper presented a unique framework for lean operations management for the HE sector based on a grounded theory research into the implementation of lean manufacturing.

Findings from the analysis of 34 interviews, using grounded theory methodology, highlighted 9 key concepts were identified and axially coded under the category of lean operations management. These concepts included: Initiative, Approach, Flexibility, Use of tools (selection), Measurement, Risk and impact analysis, Stakeholder Analysis, Project Selection and, Benefits Realisation.

From the comparative analysis the lean operations management framework is presented as a new and holistic approach to implementing lean manufactuirng within the HE sector.

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