



APPLYING *LEAN* PRINCIPLES IN A SCHOOL ENVIRONMENT TO REDUCE LEAD TIME AND IMPROVE QUALITY

Authors

B. Chibaira¹ and Teresa Hattingh²

¹Department of Industrial Engineering
University of Witwatersrand, Johannesburg, South Africa
595588@wits.ac.za

²Department of Industrial Engineering
University of Witwatersrand, Johannesburg, South Africa
teresa.hattingh@wits.ac.za

ABSTRACT

In this paper the authors will present how *Lean* principles can be implemented in a primary school environment. We discuss insights into how to reduce lead-time to go through the curriculum while improving the results. We will provide insight into the value stream and wastes in a typical classroom environment. We then present the insights so far based on a pilot class implementation at a school in Johannesburg. We also show how the use of technology can aid in the implementation of *Lean* in a classroom environment. Elimination of “wastes” of *Lean* has always resulted in lead time reductions as well as quality improvements in industry and commerce. It is with this background in mind that we are testing the same principles in a classroom environment.



1 INTRODUCTION:

Lean manufacturing, *Lean* enterprise, *Lean* production or often simply, "*Lean*", is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. "Value" is defined as any action or process that a customer would be willing to pay for [1].

Industry and commerce have been at the forefront of minimising waste using *Lean* in order to improve throughput and quality among other areas [2]. However in education systems globally and locally, the focus has been more on increasing enrolment figures and "driving" students through a fixed lead time syllabus. Success is primarily measured through enrolment figures and number of candidates meeting the minimum set criteria at the end of a twelve year curriculum. Unlike the South African matric education system where lead time has been fixed since time immemorial and the "pass mark" (quality level) has even been dropped, industry and commerce have been using various tools to reduce lead times while improving quality levels.

Improvement proposals and strategies crafted for South African schools in the past have always focused on content issues rather than technical solutions as stated by Clark [3]. Most proposals have never really focused on making the education system *leaner*. The main changes have focused on curriculum content as highlighted by Clark [3]. In some cases the content has been "diluted" to cater for known weaknesses (e.g. Maths literacy instead of proper Mathematics). In addition, some schools have been established as centres of excellence to address enrolment in "difficult" subjects e.g. Dinaledi schools[4].

In 2010, the Department of Basic Education came up with a Schooling 2025 improvement plan, of which the 2014 Action plan is part. This plan seeks to address 14 areas in learning mainly focusing among other things on quality of outputs, enrolment, and use of technology in education. This plan however, does not give any details of how to achieve it. It has been left open to schools to decide on how these goals can be achieved [5]. It is in this light that the authors wish to test if *Lean* can be used as a tool to resolve throughput and quality issues in education.

One of the reasons why the system of education has not been challenged to move in this way is because policy makers run education on a socio-economic platform [6]. If the institutions were to be run more along productivity principles similar to industry and commerce then there would be more emphasis on coming up with a *Lean* education system. The absence of technical solutions such as *Lean* in South African and global education in general has stagnated progress in this area when compared to the leaps that industry and commerce have made.

While acknowledging the problems in the education sector, Graeme Block agrees that in order to fix education, we actually need good technical solutions: "Yes, they must lead. The scrapping of OBE; better workbooks; less paperwork; emphasis on foundations of learning; these are all correct moves. However, we need more than good technical solutions "[7]. Although the application of *Lean* is still relatively new in schools, a few case studies exist on how schools in USA and Europe have been trying to adopt *Lean* in schools [8] and higher education as stated by Emiliani [12][13][14][15]. Most of these studies have been in improving administrative functions In most of these cases, education institutions have realised the expected benefits in cost reduction and quality improvement among others.



2 OBJECTIVES

The major objective of this research is to determine if the “academic production line” can be accelerated while improving quality. This entails reducing the curriculum lead time without compromising the quality of the outputs.

Secondary objectives will include

- Improve quality: a school must understand its customers' requirements and design processes that meet their expectations and requirements. Most of the DBE 2014 goals relate to quality improvement in schools.
- Designing an education tool to aid in the achievement of objectives: Industry has also been using technology to accelerate the achievement of *Lean* objectives. The authors will investigate how best to use technology in schools to aid in the core project objectives. Some of the DBE 2014 goals relate to the use of technology to improve schooling

2.1 Setting the scenario: if an industrial engineer was hired to run education

Let us imagine that an Industrial engineer has been appointed to run a company called DBE (Department of Basic Education) which manufactures a product called Matric. The Matric process goes through 12 sub processes called grades. Each sub-process consists of lessons. To achieve the goals of each lesson various tools called books/notes which are utilised. The processes operators are called teachers.

The task is to make this process *Lean* because since the process started, the lead time has remained constant at 12 years. The quality level has been set at 30% (which is the pass mark for Matric). The result has been that the international competitiveness of the “Matric” brand has been compromised and the Matric brand market share continues to go down.

In other words, it is possible to compare a classroom setup to a manufacturing scenario and therefore relate how *Lean* has been implemented in industry to the classroom environment.

3 HOW *LEAN* PRINCIPLES CAN BE IMPLEMENTED IN A PRIMARY SCHOOL ENVIRONMENT

3.1 Principles of *Lean*-adopting for the classroom

Using the five principles of *Lean* [1], we can propose a way to improve the current school education process. Following the established five-step thought process for guiding the implementation of *Lean* techniques, the approach for the classroom environment is proposed as follows.

3.1.1 *Specify value from the standpoint of the end customer by product family.*

Bicheno [9] states that it is an established marketing idea that customers buy results and not products. We have to understand who the customers and the customer's customer is or next process or next company along the chain so that product designs or service operations are not constrained by existing facilities or processes.

In the classroom, the student is the main customer. Our survey results at the school we are conducting the *Lean* project at suggest that the main value that the student requires is to achieve the best results (quality) in the shortest possible time (lead time). It is from that viewpoint that the classroom value stream should focus on delivering quality outputs in the shortest possible lead time.

Based on this, there is likelihood that the current classroom process may actually not be adequately designed to meet the customer's requirements



3.1.2 Identify all the steps in the value stream for each product family, eliminating whenever possible those steps that do not create value.

According to Bicheno [9], this is a sequence of all processes all the way from raw material to final customer, or from product concept to market launch. The value stream should be mapped with a horizontal focus while concentrating on the viewpoint of the object (or product or customer), and not on the viewpoint of the department or process step.

The schooling value stream consists of a sequence of all the processes from enrolment of a student right through to graduation. In this value stream there are sub streams which feed into the main processes. The focus of this value stream is the viewpoint of the customer which is to get the best possible results in the shortest possible time.

A simplistic view of the current process shows that there are several steps which do not create value, and hence need to be minimised/eliminated.

3.1.3 Make the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer.

Make the value flow and if possible, use one-piece or one document flow to keep it moving. Avoid batch and queue, or at least continuously reduce them and obstacles in their way. Try to design according to Stalk and Hout's golden rule, never to delay a value adding step with a non-value adding step, although temporarily necessary, try to do such steps in parallel. Flow requires much preparation activity. However, the important thing is vision: have in mind a guiding strategy that will move you towards simple, slim and swift customer flow [9].

In the school process, the main aim is to move the students at their pace, with each student's capabilities being continuously identified and harnessed. This may imply even moving students within the same class at different paces so that those who have mastered the required outcomes of a chapter/section are not "held back" by those who still have to be "processed". The current classroom learning system is batch and has a lot of waiting which results in queuing while waiting among other things for examples: papers to be marked, holidays to be completed, a teacher to be available or even for other students to catch up.

All this delays the customer (students) processes and the non-value adding processes subsequently delay the value adding steps.

3.1.4 As flow is introduced, let customers pull value from the next upstream activity.

Having set-up the framework, only operate as needed. 'Pull' in service terms means short - term response to customer's rate of demand, and not overproducing. In service, it is often capacity that is pulled, not inventory or product [1].

The proposed *Lean* processes should allow value to be pulled from subsequent processes. This means that for example if a student has met the objectives of a chapter, then they should not be stopped from moving to the next chapter so that they can start deriving value from the next "need". The current processes do not allow this to happen. In the bigger picture, schools should only be producing the required number of graduates at the correct times to meet the needs of the economy.

3.1.5 As value is specified, value streams are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue it until a state of perfection is reached in which perfect value is created with no waste.

Perfection means delivering only what the customer wants, exactly when required and without delay, at a fair price and minimum waste. The real benchmark is zero waste and not what your competitors or 'best practice is doing'. Remember that a human activity system, unlike a mechanical process, cannot be copied-because although the actions can be seen, the interactions are invisible. You can learn good practice but you cannot duplicate and



expect it to work the same way. These five principles are not sequential, once off procedures, but rather a journey of continuous improvement [1].

In the classroom, the aim is to continuously eliminate waste until the curriculum can be covered in the minimum possible time while producing 100% pass results for all the students who are studying relevant content to take them to the next stage.

3.2 Methodology:

The overall approach is shown in Figure 1. The SPORTS (Strategy, Process, Organisation, Regulatory, Technology, and Site) methodology will be adopted for the implementation. This will take consideration of the overall end to end project requirements to ensure a smooth implementation which caters for all the technical (e.g. *Lean*, learning theory, IT requirements) and human requirements e.g. change management issues.

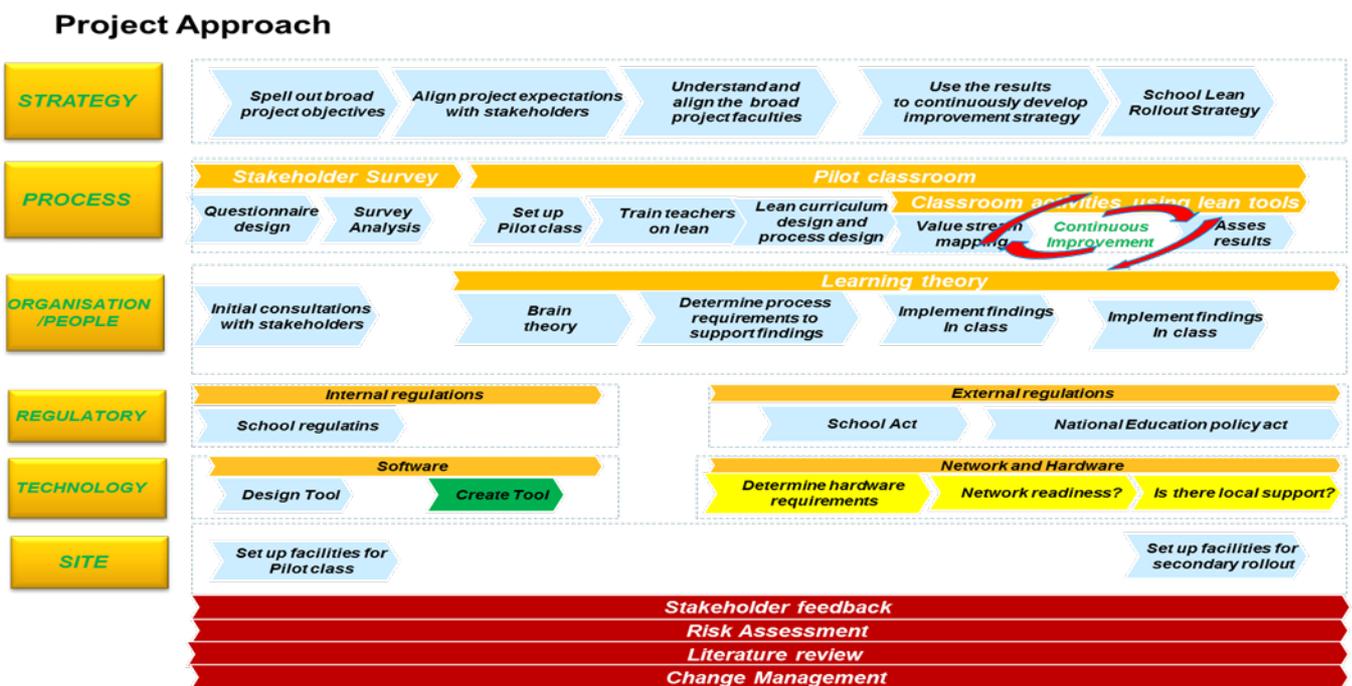


Figure 1: *Lean* in the Classroom: Project Approach

The Plan Do Check Act (PDCA) methodology is one of the *Lean* tools that will be adopted to cater for the continuous improvement cycle as shown in the diagram. The PDCA ensures that all activities which will be used to assist in the achievement of *Lean* objectives will need to be thoroughly planned, executed (Do), after which the progress will be checked and then any corrective action taken to ensure the goals are achieved. Other *Lean* tools will also be used where appropriate.



3.2.1 Plan

The school chose a subject which is viewed to be difficult (Maths) with the aim of improving quality (results) while reducing lead time.

We planned to look at and document all the processes that affect the classroom so that we could design “to be” value streams that align to the requirements of the customer. By doing so, will reduce “start-ups” and “over-processing” and thus help to reduce lead time while aligning all activities to the customer’s(student’s) goal.

We also planned to provide a detailed annual plan (timetable) with “impressions”/processes plan, “defects” identification and elimination plan to be achieved through root cause analysis. Root cause analysis is a tool used in *Lean* to determine the core factors causing a process failure [1]. During this analysis, techniques such as Fishbone analysis may also be employed. Fishbone analysis aims to dissect each problems into a fish/tree structure up to the lowest level in order to fully understand problems and eventually come up with suitable solutions [2]. Impressions in brain theory refer to the number of different processes that a student has to go through as part of the processes that help to ensure that the content being studied is retained in the long term memory [5]

Based on these we made a plan on how the classes are going to be conducted and how feedback to any scenarios would be taken care of.

3.2.2 Do

The classes will be run based on timetables which emphasize moving away from batch processing to “individualised cellular processing”. This would reduce queuing and ensure that non value adding processes would not affect the value adding processes.

We are going to implement flipped class-to save time. In flipped classes, students watch videos and do pre-homework [6]. The teacher receives results and a “corrections” schedule for each student. The teacher or system plans the lesson based on student’s pre-homework/flipped class performance. This saves time by reducing waiting time as the class skips this stage which was supposed to be completed in class. Where technology is not available, this process is done manually.

The teacher sets up “cellular class” design to enable students to go through the right impressions, while in the right groups identified through pre-screening based on the pre-homework.(see Figure 2 and Figure 3) This reduces over processing and introduces flow which aligns the teaching process to the customer’s requirement. Each student’s “defects” are identified and worked on so that ideally the student does not move to the next process with the previous process “defects”. This process is repeated over the various curriculum topics.

Additionally, tests are individualised. The tests are not similar (batch) for all students but are based on each student’s weakness (defects).

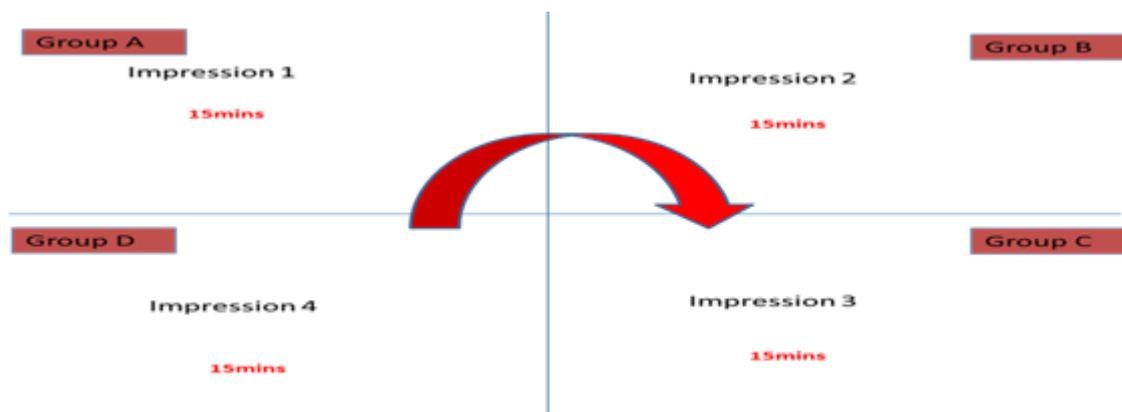




Figure 2: Class Design for *Lean*: One Lesson Structure

3.2.3 Check

The actual curriculum coverage is measured against the planned Key performance indicators (KPIs) for each individual student. These KPIs focus on quality of the output (results) and rate of coverage of the curriculum.

One way will be to continuously identify the problems each student fails and recompile them and give to the students as homework. This “iteration” process is continuous to ensure that all the areas of weakness are picked up for each student.

3.2.4 Act

Action plans are put into practice to continuously remove any waste which affects the customer (student) value stream.

4 HOW TO REDUCE THE CURRICULUM LEAD-TIME WHILE IMPROVING THE RESULTS

4.1 Lead time Reduction

The analogy we will adopt is that of a manufacturing approach. The “product” that has to be produced is a predefined grade curriculum. There are several sub processes (impressions) which every student undergoes to enable the “manufacture” of a quality product. Brain theory dictates that for information to be retained in long term memory, ten impressions have to be distributed over a period of time [7].

4.2 Processes/Sub processes

Table 1 and 2 give a proposal of the impressions (processes) from Impression 1 (I1) to impression 10(I10) that will typically be utilised in a *Lean* class to achieve the minimum “quality levels”.

Table 1: General Depiction of the Impressions Matrix

I1(Day-2) Watch Video	I2(Day-1) Pre-homework	I3(Day0) Focused lesson	I4(Day1) Class exercise	I5(Week1) Class Activity
I6 (Month1) Test	I7 (Month3) Project	I8 Month6 Revision	I9 Month 9 (link to similar concept in next grade)	I10 Month 12 Hard Overall test



Table 2: Annual Curriculum Impression Matrix (showing weeks each will be covered)

Curriculum Section (for Grade 3 Maths CAPS curriculum)	Impressions									
	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
	D-2	D-1	D0	D1	W1	M1	M2	M4	M7	M11
1.1	W1	W1	W1	W1	W2	W6	W10	W18	W30	W46
1.2	W1	W1	W1	W1	W2	W6	W10	W18	W30	W46
1.3	W2	W2	W2	W2	W3	W7	W11	W19	W31	W47
1.4	W2	W2	W2	W2	W3	W7	W12	W19	W31	W47
1.5	W3	W3	W3	W3	W4	W8	W13	W20	W32	W48
1.6	W3	W3	W3	W3	W4	W8	W14	W20	W32	W48
1.7	W4	W4	W4	W4	W5	W9	W15	W21	W33	W49
1.8	W4	W4	W4	W4	W5	W9	W15	W21	W33	W49
1.9	W5	W5	W5	W5	W6	W10	W16	W22	W34	W50
1.10	W5	W5	W5	W5	W6	W10	W16	W22	W34	W50
1.11	W6	W6	W6	W6	W7	W11	W17	W23	W35	W51
1.12	W6	W6	W6	W6	W7	W11	W17	W23	W35	W51
1.13	W7	W7	W7	W7	W8	W12	W18	W24	W36	W52
1.14	W7	W7	W7	W7	W8	W12	W18	W24	W36	W52
1.15	W8	W8	W8	W8	W9	W13	W19	W25	W37	W53
1.16	W8	W8	W8	W8	W9	W13	W19	W25	W37	W53
1.17	W9	W9	W9	W9	W10	W14	W20	W26	W38	W54
2.1	W9	W9	W9	W9	W10	W14	W20	W26	W38	W54
2.2	W10	W10	W10	W10	W11	W15	W21	W27	W39	W55
3.1	W10	W10	W10	W10	W11	W15	W21	W27	W39	W55
3.2	W11	W11	W11	W11	W12	W16	W22	W28	W40	W56
3.3	W11	W11	W11	W11	W12	W16	W22	W28	W40	W56
3.4	W12	W12	W12	W12	W13	W17	W23	W29	W41	W57
4.1	W12	W12	W12	W12	W13	W17	W23	W29	W41	W57
4.2	W13	W13	W13	W13	W14	W18	W24	W30	W42	W58
4.3	W13	W13	W13	W13	W14	W18	W24	W30	W42	W58
4.4	W14	W14	W14	W14	W15	W19	W25	W31	W43	W59
4.5	W14	W14	W14	W14	W15	W19	W25	W31	W43	W59
5.4	W15	W15	W15	W15	W16	W20	W26	W32	W44	W60
5.5	W15	W15	W15	W15	W16	W20	W26	W32	W44	W60
5.6	W16	W16	W16	W16	W17	W17	W27	W33	W45	W61



Each student will also have this impression chart on their profile, which will progressively be coloured green or red to show whether it has been accomplished or not. The techniques/activities to be used in the *Lean* class to reduce cycle time are as described in Table 3 and 4.

Table 3: Summary Table Showing the Time Needed Within and Outside the Class to Cover Curriculum

Delivery Method	Number of weeks	Comment
Tech	42	Technology allows continuous learning even outside the classroom to build up on the required impressions
Class	19	This preliminary impression plan shows that the 8 impressions to be done in class require about 248 lessons which can be accomplished in 124 hours (taking each lesson to be 30 minutes). This effectively leaves a slack of another 156 hours (Maths lessons are allocated 7 hours per week for 40 weeks). This already theoretically provides enough time to cover another grade (assuming same number of concepts to be covered at next grade)

Table 4: Time Improvement Techniques

Item	Improvement Emphasis	Comments
1. Flipped class:	Time	Record videos for students to watch classes before the main lessons (these are not substitutes for the main lessons)- the main lessons are now meant to address issues picked up from the pre-homework which is done before the main lesson
2. Automated marking	Time	Reduces teachers marking time from 4hrs a week to 2hrs. All multiple choice and structured questions can be automatically marked

4.3 Quality Improvement Focus

The current quality control system for the primary school system shows that even a lot of students who have not met the basic requirements of the previous grade are “pushed” to the next stage of the process (next grade) as detailed in the process shown in Figure 4. This

scenario results in students struggling with even more advanced concepts in the subsequent grades.

Figure 4: Current quality control system in the Department of basic education

Figure 5a: Proposed “Lean classroom” quality assurance system

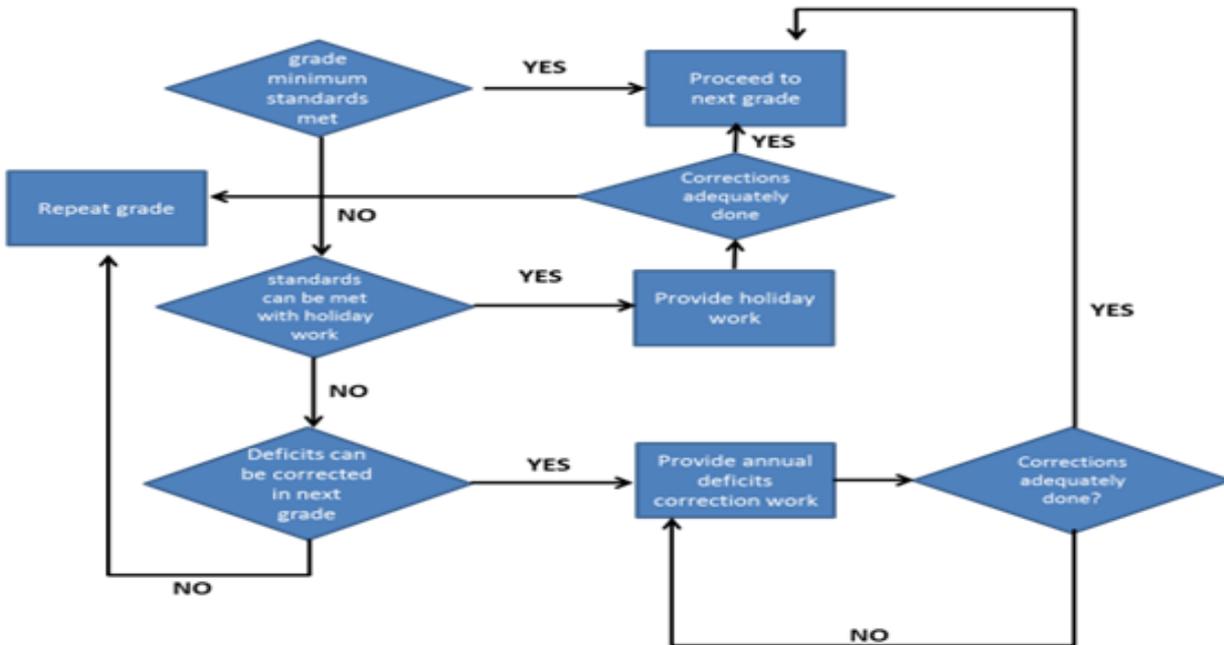


Figure 5b: Proposed “Lean classroom” quality assurance system

While the impressions as described above will help to improve quality of output, the cycle in Figure 5b ensures that any areas of weakness that have not been accomplished after these impressions are noted for each student, manually or electronically so that the student will get the necessary help from the teacher or by other means. Even when the student moves to the next grade, these ‘errors’ are still noted so that the next grade teacher can understand which prerequisites have not been accomplished. The internal reports will indicate where each student needs to work on in order to overcome “defects” and not meet challenges in the next process.

After each impression, a checking mechanism updates the teacher on whether each student has completed the prerequisites for each of the subsequent topics. The revision exercises will emphasize on those areas.

The proposed system thus moves towards quality assurance, whereby each stage is checked and passed off or if it is not satisfactory, then corrective measures are taken before moving to the next stage. Fig 5 below shows the actions that the project will take to improve on the quality output of the students results



Table 5: Quality Improvement Focus

Item	Improvement emphasis	Comments
1. Impressions	Quality	There will be 10 impressions spread over a year or more. This requires synchronisation of grades curriculum as some impressions run into the following year
2. Profile tracking	Quality	Each student's profile will have reports on what questions have been answered and what the performance was, what content has been accessed and for how much time. Videos and questions of corrections will also be attached to the profile, and will only be removed once satisfactorily completed.
3. Focus on individual defects	Quality	In the class, the emphasis of teachers/tutors should be to eliminate the defects identified in the pre-homework

5 VALUE STREAM AND WASTES IN A TYPICAL CLASSROOM ENVIRONMENT

The project will process map all the critical process that affect the classrooms. These processes include:

- Creation of an annual plan and timetable
- Conducting a lesson
- Conducting an activity(impression)
- Marking
- Giving feedback
- Setting a test

We then identify the “wastes” as shown in Table 6. We then redesign the process to eliminate/minimise the waste. The following is a redesign of the “wastes of *Lean*” to equate to the education practice example [12].

**Table 6: Type of Waste Education Practice Example**

Type of waste	Education Practice example
Motion (people)	<ul style="list-style-type: none">• Students and teacher travelling to multisites, to different classrooms, throughout the same day.• Poor classroom layouts restricting the movement of the teacher around the students.
Transport (goods)	<ul style="list-style-type: none">• Photocopying department is on a different site to the delivery of lessons, hard copy sent to reprographics via internal mail, copying completed and returned to site of origin (10 days lead time)
Skills utilisation	<ul style="list-style-type: none">• Teachers delivering above their own knowledge as a stop gap, or even in reverse covering classes that do not utilize their full potential.
Over-Production	<ul style="list-style-type: none">• Multiple copies of hand-outs just in case students have mislaid their copies!• may refer to developing too many different lessons/subjects that are not adding the required value
Over- Process	<ul style="list-style-type: none">• Over assessment of same outcome which appears in different subjects/ modules, students undertaking additional subjects outside the ones required to get the next job.• Providing much more than what is required for the validation process. This can also be in the form of too many individuals involved in checking the same work.
Defects	<ul style="list-style-type: none">• Students not achieving the required learning outcomes or having to re-sit/re-submit course work,• Lecturing staff marking and giving feedback more than once on the same piece of work.
Waiting	<ul style="list-style-type: none">• Feedback on assessment or achievement of learning outcome(s),• Long waiting to start the next academic year.• Waiting for lectures to be done in class
Inventory	<ul style="list-style-type: none">• Students can be classed as inventory, they are raw material at enrolment, work in progress for the period of programme study and finished goods until the qualification is obtained.

Another example of a process change will involve the annual plan creation. The process in Figure 5 depicts the current annual plan creation process (blue) and the proposed “Lean” to be process. The difference is that the two new green blocks have been added. In looking through the curriculums, it has been observed that there are common areas that can be grouped together. This will reduce the number of start-ups and increase the scope/coverage in single lectures. As one of the project aims is to accelerate the rate of curriculum



coverage, the grouping of common themes across grades enables the reduction in over processing, as the impressions (processes) are then designed to cover common themes and thus reduce time needed to achieve the same goals.

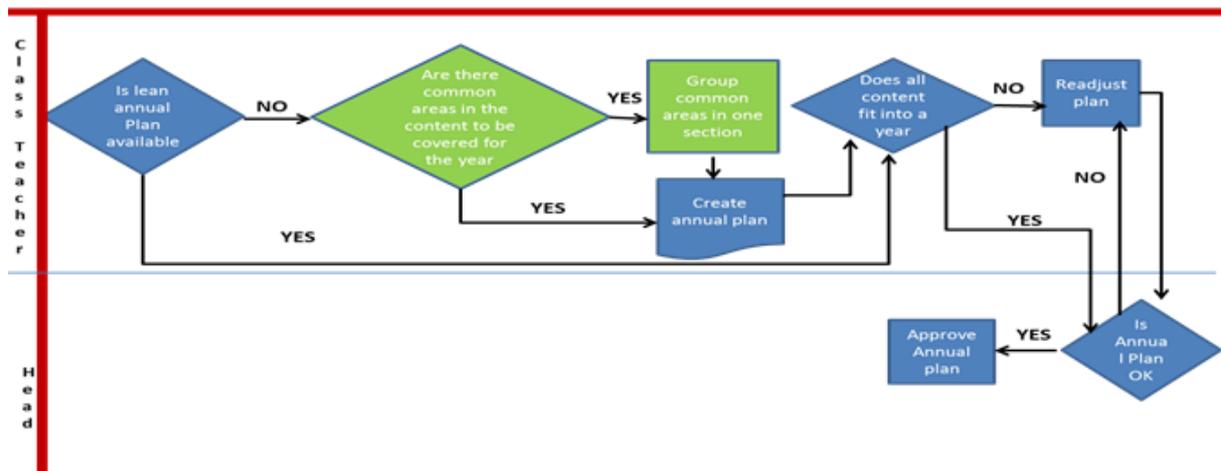


Figure 6: Creation of an annual plan

6 INSIGHTS SO FAR BASED ON A PILOT CLASS IMPLEMENTATION

6.1 Plan

The current method of creating an annual plan involves fitting the curriculum into the number of days in the academic year whereas the lean approach will involve grouping curriculum content first into common themes and then structuring a “learning plan” based on content to be taught and the number of impressions (sub-processes) to be executed. The class timetable is to be created with more emphasis on achievement of the impressions plan.

6.2 Do

Currently all lessons are conducted within the classroom, however in the lean setup, a significant amount of work (up to 50%) that is normally done in the classroom and “extra impressions work” that is normally not done is now performed outside the classroom through videos, pre and post homework as well as revision exercises. This will reduce waiting time. Teachers will plan the actual lesson based on pre-homework feedback. This helps to focus lessons on areas of need and reduces over processing. Implement impressions plan using the “cellular-class” concept

6.3 Check

Currently all the Marking of student’s exercises is manual and time consuming. Introducing an IT tool will automate the process. This will reduce the time needed by the teacher to check students work and opens up more time for the teacher to do more value adding work such as delivering lectures and planning for lessons. Currently parents access to children’s work is limited to a few days when appointments with the class teacher can be made. However Sms/email notifications to parents on students’ progress and parents access to children’s work online will enable them to be actively involved in their children’s work and



thus helping to ensure that they do their homework as parents will be asked to check on them.

Additionally at the moment homework/tests/exams are batched. The class gets the same homework regardless of different strength and weakness profiles. In the lean setup, tests are no longer random but more focused on “eliminating defects” identified in the prior processes. Individualised tests will now be based on identified “defects”

6.4 ACT

Currently students may do corrections through extra lessons and other students enrol for external classes in order to catch up on areas needing attention or in order to accelerate their learning pace. Lean classes will identify and correct all individual student’s needs and ensure that any quality issues are dealt with at school. Each student will also be given a chance to cover the curriculum at the pace they can without being slowed down necessarily by the rate of other students

7 HOW TECHNOLOGY WILL HELP IN THE IMPLEMENTATION

Learning theory says that a certain number of “impressions” have to be performed to enable retention of information in the long term memory [5]. Table 2 above shows that using the recommended ten minimum impressions, there is enough time to complete the curriculum. . We also need to track that these impressions have been actually done

In order to properly manage the impressions without adding burden to the teachers’ administrative work while also reducing the lead time to complete the curriculum, we designed an IT tool to help manage the process. This tool will help the class to implement the “flipped classroom” [6] concept which enables students to watch their teacher presenting lessons at home or wherever they are. The flipped classroom concept reduces the waiting time. Based on what they have watched, the students write a “pre-homework”. The results are sent to the teacher who then plans for the next lesson based on how the students have performed in the pre-homework. In the lessons, the teacher focuses on the “defect areas”. The aim is also to avoid unnecessary “processing” during the lessons. After the “more focused” lesson in which the teacher focuses on eliminating defects identified for each child, another homework is given to determine how much of the “defects” have been eliminated due to the more focussed lesson

7.1 What the technology will do to support *Lean* intervention

7.1.1 *Enable Lean Planning*

The teacher will upload Excel data with a given format/template. This data will consist of the curriculum topic, number of learning weeks available in a year (i.e. full year less holidays, examinations period, an allowance or trips and other activities, prerequisites, similar topics grouping, all types and number of impressions. After this the *Lean* curriculum planning tool will produce a plan showing a curriculum/impression coverage plan.

There will be a tracking system which will show how the classes are covering the plan and an alarm system to help implement corrective measures if the class is lagging behind.

7.1.2 *Enable quality improvements through impressions monitoring*

Brain theory advocates for about ten impressions spread over a period to enable long term memory retention of information. Long term retention may improve the quality of results. If all these required impressions are performed manually, then the actual curriculum coverage may be slower although it will still be possible to accelerate the classroom based on Table 2 above.. However if some of the impressions are done using an IT tool, then students can do these impressions outside the normal classroom time, which frees up classroom time to



activities which enable the teacher to focus on “waste” removal activities, rather than batch processing activities. All this should result in quality improvements through better results.

7.1.3 Enable reduction of time through efficient utilisation of time.

The use of technology enables some of the work that is normally supposed to be done in class to be done outside normal classes enabling the acceleration of the curriculum. Using the grade 3 Maths curriculum, it is theoretically expected to improve the rate of curriculum coverage by up to 50% which results in theoretically saving two terms in each academic year resulting in a year’s reduction every two year cycle. The teacher also saves significant marking time as about half of the work will now be automatically marked. However the experiment will initially target a 25% reduction

8. CONCLUSION

The success of this project can have significant effects to the economy if the results are implemented in schools on a large scale. *Lean* has been known to bring significant improvements in industry and commerce and , thus successful implementation of *this project* can have the same results in schools, namely:

- reduced lead times for delivery of content
- better student results(quality of the output)
- budget increase per pupil over the long term

The education system is the major provider for skilled resources for the South African economy. It is also gets the second biggest budget allocation from the national fiscus. Acceleration can also potentially improve throughput for the job market. The students will benefit from the ability to finish the curriculum in a shorter period and enter the job market/college much earlier or use the extra time to polish up areas of need. In the long term it will also mean a need for less schools/infrastructure, leading to further budgetary savings. For example eliminating 1 year in a 12 year curriculum by accelerating the learning process by 8% can lead to a process cost reduction by R200bn over 12 years[based on the annual budget of R200bn [9]). This will also lead to a need for less infrastructure such as schools and related equipment.

Literature review shows that an industrial engineering based approach to reducing the cycle time is conceivable. It is the authors’ desire to assess if the success stories in manufacturing, health and finance [1] can be achieved in the education sector.



9. REFERENCES

- [1] **Womack, J. & Jones, D.** 2003. *Lean Thinking*, revised edition, Free Press
- [2] **Bicheno, J.** 2008. *Lean Toolbox for Service Systems*, PISCE Books
- [3] **Clark, J. & Price, M.,** *Fixing South African Schools*
- [4] **Department of Basic Education 2025 Strategic Plan:** INTERNET
<http://www.education.gov.za/>
- [5] **Stevenson, H.W.** 1972. *Children's Learning*, Apple Century Crofts.
- [6] **Salman Khan.** 2012 *The One World Schoolhouse: Education Reimagined*
- [7] **Ziskovsky B.** 2012 *Optimising Student Learning*, ASQ Quality Press
- [8] INTERNET <http://sahistoryofeducation.webs.com/SA%20timeline.pdf> accessed 22 February 2013
- [9] INTERNET
<http://www.education.gov.za/LinkClick.aspx?fileticket=kKd2AhtjxYo%3d&tabid-422&mid=1261> accessed 2 March 2013
- [10] **Trevors, R.** 1973. *Educational Technology and Politics*, R.M.W Second Hand Book of research on Teaching, Rand McNally, pp 979-997
- [11] **Graeme Block-Fixing School Foundations-**[http:INTERNET//graemebloch.com/](http://INTERNET//graemebloch.com/) accessed 1 March 2013
- [12] **Emiliani, M.L.** 2012 *Faculty Home Page*
- [13] **Emiliani, M.L.** 2005. *Using Kaizen to Improve Graduate Business School Degree Programs*
- [14] **Emiliani, M.L.** 2009. *Improving Higher Education*, Unpublished work.
- [15] **Emiliani, M.L.** 2010 *Lean Higher Education, Increasing the Value and Performance of University Processes*
- [16] **Natalie J. Sayer, Bruce Williams** 2012. *Lean for Dummies*
- [17] **Dalin, P.** 1978. *Limits to Educational Change*, McMillan International College Edition.