Lean Six Sigma Approach to Improve the Admissions Process for a Nigerian HE Institute

Anthony Oko and Parminder Singh Kang

Abstract: Lean as a management paradigm has been applied extensively in manufacturing industries, and so little has been done in the area of its studies and application in managing affairs in education. This paper exemplifies the applicability of Lean Six Sigma approach for higher educational institutes. The problem solved is that of ineffective and inefficient admission process in the ELITE state polytechnic. The project is aimed at proffering a workable and a viable improvement process for the admission of candidates for the ELITE state polytechnic that will be more attractive and have more value for customers and above all, create more wealth for the polytechnic community. The need for improvement is presented in responses from respondents in the question two of the questionnaires. A total of 70 respondents, representing 85% indicate their dissatisfaction with the admission process. To improve the admissions process, the Lean Six Sigma based methodology, DMAIC was applied. A qualitative research analysis was used in analyzing the questionnaires, since the method seeks to understand and the research problems from the perspective of the local population. A test shows positive results when compared with the old practice. There were improvements in a circle, takt, lead and utilization times, reductions in idle time and rework, likewise the process circle efficient (PCE). The results are presented in the current flow chart and the value stream maps.

Index Terms— Lean Philosophy, Higher Education Institutes, Six Sigma, Continuous Process Improvement

1 Introduction

To stay competitive and improve the profitability, manufacturers and service providers are continually striving to improve productivity, reduce costs and enhance customer service. There can be no surprise that a rapidly increasing number of organizations are looking forward to introducing the Six Sigma process improvement methodology [1]. According to [2] "there is a clear misconception across many public sector organizations that the Lean Six Sigma (LSS) is suited solely to manufacturing companies, however the situation in the Higher Education (HE) sector is very similar to that of firms within the manufacturing and service industries". Education is one of the essential services that are provided to customers (students) by organization (Higher Education Institutes (HEI)) [3]. Due to increased competition between national and international institutes, it has become utmost important to streamline the associated services and processes, such as admissions, administrative, examination, etc. [4]. This forms the key focus of this paper, where the admissions process is investigated to make it more efficient by reducing the waste. This paper investigates the admissions process for ELITE State Polytechnic, Nigeria to reduce the waste in order to improve the decline in admissions and the student's experience. This is discussed in detail in problem formulation section. The paper is organized as; first it introduces the Lean Philosophy and Six Sigma. The second section exemplifies the current implementations in HEIs. Then, the problem is formulated in the third section. The fourth section illustrated the proposed methodology and finally results discussion and future works is included in section 5 and 6 respectively.

1.1 LEAN Philosophy

Lean is a simple strategy of removing "waste" from a process. Waste can be caused by many things such as redundant steps, variation in the process, work imbalance, quality issues,[5 and 6] "Lean," essentially is a philosophy which tends to look at the process of removing "waste" from a process [5 and 6]. Lean thinking has been applied in a wide range of industrial sectors, from the Toyota production system (TPS), through the industrial revolution in Japan and the west. The Manufacturing industries embrace the lean thinking in the management of their organizations so as to attain their objectives of higher gains and the creation of more wealth. The application of lean thinking, therefore, is the beginning of the awareness for finding individual firm's solutions and their improvements through the value chain [4].

Organizations who adopted lean principles as its managerial skills, at this stage are called "leans thinking organization" [5]. Typical is the implementation of value stream mapping and the five lean principles developed by Toyota. Even though some of the practices and tools of lean are questioned, lean organizations have done quite a lot to prove its worth in terms of growth in wealth and popularities through its successes [1]. Lean, a continuous improvement methodology, is characterized by using fewer resources to design, produce, market, and deliver products and services. HE sector as a service industry should be able to follow a similar paradigm as of manufacturing and other service organizations to minimize the waste and improve profitability.

1.2 Waste, Value and Lean Principles

Explanation of Lean philosophy is incomplete without mentioning value and waste. It is important to note that enormous literature exist on value and waste. Therefore, this

- *Dr Parminder Singh Kang is Research Fellow; Contact Details: Lean Engineering Research group, Faculty of Technology, De Montfort University, Leicester, LE1 9BH, UK, PH- 0044 116 207 8089, E-mail: pkang@dmu.ac.uk*
- *Anthony Oko is currently a senior lecturer in mechanical engineering department, Benue state polytechnic, ,P.M.B 001,Ugbokolo. Benue state, Nigeria. E-mail: anthonyoko19@yahoo.com.*

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section briefly explains what is value and waste.

Waste is any activity that absorbs the resources, but creates no value for end customer [5, 7 and 8]. For example, changeover/tool change is an important activity in the production process to produce required and high quality products, however this doesn't add any value from the end customer prospective. Therefore, this is regarded as waste, which needs to be reduced. The main characteristic of lean is its focus on waste elimination. The focus is so critical that [5] identify seven waste categories: overproduction, waiting, transportation, over-processing, inventories, moving, and defects. Table 1, exemplifies the seven wastes [5, 7 and 8].

Value is very important in the context of lean. A customer must have value for what he/she wants from the provider. Therefore, value must be such that it is the main attraction in the services rendered. [5] suggests there are three possible classifications of value: activities that the customers are willing to pay for (value-added); activities that are necessary, even though the customers are not willing to pay for them (essential non-value-added); any activities that are not necessary and that the customer is not willing to pay for (non-value-added). Therefore for added value activities, the producer must identify the value in its product, and then mark out the process flow or value stream, create the flow process from the point of placing an order to the point of delivery. Next in the process is to establish pull process and this by understanding what the customer wants, the time and acting quickly to his needs and finally continue to seek and maintaining perfection after creating value for your products. Waste in the context of HE means what could constitute obstruction in the underlying process, causing undue delays and need to be eliminated for free flow of the process. For instance, [4] asserts that students, research, and staff are the three main levels or fundamental blocks in any HEI. He posited that since students and research are the two main sources of income for the institution, whatever constitutes waste need to be removed from the activities in value stream to bring about maximum benefits from such process. Five Lean principles are [4, 5 and 6];

- **Identify Value;** the first step in every lean problem solving is identifying where the problem lies and the values specified. This makes it easier for waste to be targeted and eliminated.
- **Map Value Stream;** map out the value stream for the entire set of activities or plan an end- to- end set of activities that are linked. This is actually the set of activities or process necessary to realize the value, streamline it after eliminating waste.
- **Create Flow;** this is removing any delay in the work process such as delay in the manufacturing process to the time of delivery to customer.
- **Pull;** here one need to understand what the customer wants with the view to responding accordingly to a specified time. That is make one sell one.
- **Pursue Perfection;** the motive here is to constantly improve on the process and perfection thereby creating a system of respect, trust, honesty, cooperating and motivation of staff exhibit capabilities.

TABLE 1
LEAN WASTE

Waste	Definition	Example
Over-production	Producing too soon or too much than required	- Information sent automatically even when not required - Printing documents before they are required - Processing items before they are required by the next person in the process
Defects	Errors, mistakes and rework	- Rejections in sourcing applications - Incorrect data entry - Incorrect name printed on a credit card - Surgical errors
Inventory	Holding inventory (material and information) more than required	- Files and documents awaiting to be processed - Excess promotional material sent to the market - Overstocked medicines in a hospital - More servers than required
Over-Processing	Processing more than required wherein a simple approach would have done	- Too much paperwork for a mortgage loan - Same data required in number of places in an application form - Follow-ups and costs associated with coordination - Too many approvals - Multiple MIS reports
Transportation	Movement of items more than required resulting in wasted efforts and energy and adding to cost	- Movement of files and documents from one location to another - Excessive e-mail attachments - Multiple hand-offs
Waiting	Employees and customers waiting	- Customers waiting to be served by a contact centre - Queue in a grocery store - Patients waiting for a doctor at a clinic - System downtime
Motion	Movement of people that does not add value	- Looking for data and information - Looking for surgical instruments - Movement of people to and fro from filing and fax.

1.3 Six Sigma

Six Sigma can be categorized into two classifications; the matrix and the methodology. On the whole, six-sigma can be looked as a "statistically based project driven approach to improving the organization's products and production system to achieve near perfection or 'closest to zero' product by focusing on defect rates in order to eliminate the variation in a process [6 and 8]. The matrix is a measure of how good the quality of processed. The methodology is probably what Six Sigma has

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become well known for today. DMAIC, as it is known, is a five phase methodology which uses a scientific and data driven approach to find the optimal solution to a business problem. It is an improvement process model which uses data as a quality strategy.

DMAIC is an acronym for the five phases that make up the process [5, 8 and 9]:

- **Define** the problem, improvement activity, opportunities for improvement, the project goals, and customer (internal and external) requirements.
- **Measure** process performance.
- **Analyse** the process to determine root causes of variation, poor performance (Defects).
- **Improve** process performance by addressing and eliminating the root causes.
- **Control** the improved process and future process performance.

DMAIC forms an integral part of six sigma initiatives, however, it can be implemented as a quality improvement drives such as lean.

The marriage between lean and six sigma, which lead to the formation of Lean Six Sigma ideology is recognized widely and has been, implemented predominately both in manufacturing and in the construction industries. While lean focuses on creating value through waste elimination for efficiency in the process, six sigma concerns its self with reducing variation in the process through the application of the six sigma tools. Based on this, it is anticipated that a similar approach could provide enormous benefits to the HEI sector too.

2 LEAN-SIX SIGMA AND HEI

Lean, from its inception has been a management philosophy for the manufacturing industries. History reviews that what transformed into lean began as Toyota Production System (TPS) in Japan before being introduced to the West. And those industries which adopted lean as management Philosophy accrued many benefits to their organizations.

Lean after achieving good results for Toyota was popularized amongst other manufacturing industries in Japan and later spread to the West. Today, Lean has been successfully implemented in other industries such as defence and military, NHS, software development process as applied nowadays at eBay to reduce all unnecessary steps in its trading chain. [4], information management, business management, the hospitality industries and even in public services. [10] Has urged that lean in HE was in a nascent stage, therefore, implementations were difficult to assess, and however, early adopters experienced significant changes or results. This could be in terms of process improvement and employee engagement [11].

Lean methodology has become more common in the HE to reduce waste, streamline the process [12]. [4] Argued that the higher educational institutes, in these modern days, are in continual competition with one another. This, according to him, is for them to woe both internal and international students to the various institutions in competition so as to increase funding. And this means that, each of these institutions in competition will have to increase its quality of education, learning environmental, laboratory, library and lecture facilities.

In Nigeria, for instance, the competition is high between the Government owned Higher Educational institutions (GHEI) and those of privately owned institutions. Even though the cost of educating a child is high, the private HEI are gaining more ground because of the quality of services, consistency, free flow of programs and stability of term works and time. [13] The case is however different in the Government owned Educational Institution due to incoherency in their service delivery, and incessant strike actions by both academic and non-academic staff. For instance, in terms of service delivery, [13] posited that students of the intuitions in private tertiary institutions are more certified with certificate collections than those of government owned institutions as applied in Nigeria.

It is therefore of the writer's view that higher education worldwide, is no longer just government agencies offering education to the needy and applying the normal management principles filled with waste but a an organised system now in completion to achieve greater goals because of challenges facing then.

Views by [14] also collaborated, that higher education has moved from a model focused on accountability to one focused on improvement, and lean methodology is increasingly seen as a central strategy for improvement.

In his book[15] defines lean in HE as defining the value of processes from the perspective of beneficent identifying process flow, eliminating the type of waste that add no value, making process flow more smoothly and pursuing perfection through a combination of continuous improvement and radical transformation of the process. This definition according to [16] align closely with the model used in the Toyota production system (TPS) chronicled by Womack and Joan (1996). According to Balzer (2010) as cited in [16] also provided examples with flow diagram and value stream mapping that clearly show where processes break down due to wasted materials and time.

Overall, [4] argues that HEI must demonstrate that they can offer what others cannot. He stated that this is achievable through the optimal use of resources which efficiently reduced waste from the different activities. [17] Explains how graduate admission was increased between 2004 to 2007 using lean application & tools. Before then, a survey conducted shows a drastic decline in the number of applications and admission offered to international students with emphasis on areas of science and technology. However, with the introduction of the collaborative degree program, the situation changed for the better. With the collaborative degree programs, the system allows students to receive a dual or double degree such that students take courses and receive a degree, Diploma or certificate from each participating college or university. This entire program was triggered due to continued competition among American grade schools and international colleges and universities.

In order to reduce the operational cost and improve quality of service, [18] gave five reasons why Lean should be implemented in H.E.I

- It saves time and reduces waste
- It organizes classrooms, storage of office space

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- Improve customer services and student experiences
- It standardizes processes
- It is a means of avoiding cost.

[18] Also stated that three common advantages are experienced by organizations that undertake lean initiatives, i.e. creating and understanding the need to change, revising processes & practice which has been untouched for years and engaging staff to enable them to face challenges and question their work place.

3 Problem Statement

Admission of students with high intellect into the ELITE State Polytechnic has been on the decline in recent times. Recent studies, as established in the questionnaire, reveals poor and inappropriate admission process, accompanied by many ingredients of waste in the process. It is for this and other reasons that the writer decided to research into the admission process of the polytechnic with the view to proffer solutions through an improved method that will eliminate waste, thereby creating value for the customers, and bringing about wealth creation and customer satisfactions. The writer views with optimism that in the end, admissions into the polytechnic would have become very credible and attractive to the brilliant students and also enlarging the scope of admission, in terms of increased numbers of intakes into the college. However, Theresa Waterbury opined that, "a redesign of an admissions process may depend on a fine balance of policies, procedures, recruiting practices, technology, faculty and staff involvement, and applicant academic ability." It is also his views that, with commitment from the staff and students of the college, the improvement process would be a great success and could attract funding for the school. It is based on this that the writer decided to go into this work based on the following underlined objectives.

1. To identify areas of waste in the admission policy and process of the polytechnic
2. To proffer an improvement process that will identify with the present state.
3. To draw a process plan that will identify with the new improvement process.

The scope of this project will be limited to understudying the problems in the admission process of ELITE state polytechnic, evolve a process that would bring about solutions in terms of reduction or total elimination of waste in the current admission process of the ELITE state polytechnic in Nigeria, and proffer an improvement process that will give the customer value for their wants.

4 Methodology

To improve the admissions process, proposed approach uses the Lean Six Sigma based methodology. A qualitative research analysis is used in analysing the questionnaires, since the method seeks to understand the research problems from the perspective of the local population [19]. That is, the researcher seeks to solve the research problem using opinion of the population at the source. Therefore evaluating the key success factors, as well as other factors that would influence the implementation of lean six sigma principles as a management protocol in a higher educational institute [7] such as the ELITE state polytechnics in Nigeria are the major problems in this project.

As stated earlier a DMAIC model of LSS improvement methods will be applied in solving this problem of the polytechnic. DMAIC stands originally for Define, Measure, Analyse, Improve and Control. It is a five phase structured methodology used for defining a business problem and finding out what problems need to be targeted for change and finally finding a solution to it. That is, the DMAIC model can be looked as scientific and data driven approach to finding solutions to business problems.

1. Define: The problem of the polytechnic as stated earlier in the literature is that the admission process of the polytechnic is marred by unwarranted administrative protocols, unnecessary delays and bottlenecks that the customers are left unsatisfied and not getting value for their services or wants. This is because the administrative set up of the institution is purely public service and is filled with so much waste in the process that has coursed administrative setbacks for the management of the institution. The result is that, the customers who are the candidates seeking admission are left unsatisfied and frustrated. The resulting wastes as stated in the literature include the seven wastes experienced in most processes that are not lean six sigma compliance. This is as enumerated in the findings, includes poor service delivery, poor methods of communication and information delivery. A current flow chart of the process in Figure A.1.

2. Measure: The Measure phase is the second phase in the Six Sigma or DMAIC methodology. This phase measures the metrics and measurement systems for the inputs and outputs of the projects that are formed. The phase also ensures that the right data are collected from the right place and methods of getting the data are accurate. In order to figure out areas of waste in the process, there is that need to calculate the baseline performance of the process at the beginning which is presented in the value stream map in Figure A.2. It is evident that the cycle time and takt time are major indicators of areas of waste in the process. The takt time is calculated based on the following parameters. 8 working hours considered between 8.00 am and 4.00 pm on a single shift. A break time of 30 minutes and launch time of 30 minutes. The expected average number of forms to be sold per day is 50. {That is 8hr x 60 x60 = 25,200sec/50pieces = 504sec/piece}. From the VSM in Figure A.1 the Cycle time is 1800seconds with a process lead time of 53days and the value added time (VAT) of 26,400sec. In this phase other measures which need to be put into consideration will be how to reduce lead time, cycle time, rework, work in progress (WIP) and idle time, which in the process increase utilisation time and PCE (currently 1.98% - Figure A.2) to achieve our aims and objectives.

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The second main aspect of the measure phase is to collect the necessary data in order to feed the analysis phase. The research has used questionnaires to collect data from the perspective of local population. The main focus was to collect data about the admissions process from the students, higher level management and admissions department and the performance measure to establish the current state i.e. solving the research problem using the opinion of the population at the source. The population is the entire staff of the population;

- 110 Staff are given the questionnaires and are independently chosen.
- Out of this 82 responses were received, their views representing the views of the entire staff of the polytechnic that didn't have the opportunity of participating in the exercise.
- Each respondent was chosen based on respondent's acceptance to participate without special preference given to any respondent.
- The questionnaire is specifically designed to attend to the project question, "how lean six programs would be applied to improve the admission process in ELITE state polytechnic?"

3. Analyse: Results analysis is the third phase of the DMAIC model and usually the longest phase in the Six Sigma methodology. Most of the crucial data analysis is performed in this phase. This phase usually leads to exposing the root causes of the problems and provides insight into how to eliminate them. From the responses it is obvious that there is a need for change in the management practice of the institution as regards admission to eliminate the waste in the process. The respondents were also unanimous in accepting the fact that the methods of communicating and information delivery to the various offices were very poor. The same goes for methods of placing adverts for admissions and placing of admission results with 96% accepting that was it very poor. The study also shows that it takes longer period for applicants to duly complete their forms and submit it. In the final analysis the general opinion is that electronic medium should be used for processing of admissions, placing adverts for admissions and placing the results of admission to candidates in order to reduce incidence of waste in the process. Table 1, consolidates all the data collected from participants. From Table 1, the key issues can be illustrated as;

- ***Q1;*** Of the 82 respondents, the largeness of the academic staff shows their involvements in the academic and admission issues in the polytechnic and probably the entire registry staff responding. The respondents in "any other staff" category only make and support the numbers of respondents required to duly get the lean implementation process on the way of achieving the required objectives.
- ***Q2;*** 85%, agreed that the admission process is actually very poor or poor. Only15% had contrary view. This percentage is only made up of those in the management cadre. This point to the fact that there is a lot of waste in the process which need be identified and removed so that the process can flow without delay.
- ***Q3;*** Rating the academic qualification of candidate's shows that it is slightly on the average with about 48% responding positively. The remaining 52% responded negatively that the qualifications of the candidates were on the decline therefore the need for improvements.
- ***Q4;*** the longer the period, the more the lead time, which causes problems of inventory control and completion time.
- ***Q5;*** No-one responded that e-mails or computer network was used as a medium of communicating. This also leads to increased lead time resulting in waste of transportation due to delay in information delivery.
- ***Q6;*** Shows that there is a clear need to improve the sales process of application forms. Only the 5% indicating that it is good; this could be coming from those in the management cadre or some respondents who are not properly informed.
- ***Q7;*** About 96% of respondents accepted that the process as very poor/poor. Hence, lead time is increased due to non-value added time spent in travelling to the polytechnic just to view results resulting in unnecessary waste in motion and travelling. Therefore, clear need for improvements in this process.
- ***Q8;*** shows a clear need to improve the process by adopting the online advertisement system to attract more candidates.

TABLE 2

SUMMARY OF COLLECTED DATA

Q. No	Question/Information (Unit of Measure)	Response Category	Quantity (Number)
1.	Type of Participant (Respondent) – Total 82 (Number)	Management Staff	4
		Registry Staff	26
		Academic Staff	32
		Other Staff	20
2	How would you rate the admission process to the polytechnics? (%)	Excellent	0
		Very Good	15
		Poor	28
		Very Poor	57
3	Rating of academic qualification of candidates applying. (%)	Very High	13
		High	35
		Low	42
		Very Low	10

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4	The period it takes for applicants to fill and submit completed forms. (%)	Less than 3 Days	3
		Between 3-7 days	24
		Between 7-21 days	40
		More than 22 days	33
5	How are files moved between management and admission department? (%)	Messengers	68
		File Clerks	32
		E-Mail	0
		Computer – File Sharing	0
6	General Feelings towards the methods of sale of admission form? (%)	Very Good	0
		Good	5
		Poor	28
		Very Poor	
7	General Feelings and opinion towards the method of for communicating qualified Candidates? (%)	Very Good	0
		Good	4
		Poor	38
		Very Poor	58
8	Which medium of information would you prefer to advertise admission? (%)	School Board	8
		Radio Jingle	26
		Newspaper	4
		Online Advert	62

4. **Improve**: From history and data collected, it was observed that waste is prevalent in the entire process of admission at ELITE state polytechnic. The current state value stream map in Figure A.2 exposes those areas of waste. For improvements a future state value stream map is drawn to encompass the various forms of improvements. The Value stream map is a visual representation of all steps of a process involved in achieving the customer demand. It is a diagnostic tool that focuses on improvements which involves all the steps that requires to bring a product or service from a raw state to the customer [7] In order to achieve high reductions in idle time, takt time, cycle time and rework the following improvement drive are offered to reduce which will result in increased utilisation time and process cycle efficiency (PCE);
   a. It is recommended that admission advertisements should carried online network, instead of the school's notice boards. This would have reduced energy wasted in going to the radio house in terms of fuels and efforts.
   b. While admissions scratch cards can still be sold in the some designated banks, processing of application forms by applicants would be online. This will reduce the time and energy spent in filling forms manually before submitting. It will also reduce incidence of rework therefore reducing the cycle time, because idle time will be reduced.
   c. Application forms are also submitted online. In this case, waste is reduced in terms of applicants travelling from point of purchase of form to the polytechnic premise, to submit form. This will reduce processing time and of course, process lead time.
   d. Processing admissions are now itemized and scheduled to meet the new technological challenges in management against the old practice. Therefore, as presented in the future state value stream map, kaizan and kanban lean improvement processes were applied so that, at every moment 10 applications can be processed sequentially to reduce incidence of accumulation of inventory and change over time.
   e. Results will be released online to enable applicants view with confidence, their names on the scream of the computer network instead of the school notice board, as was in the old practice.
   f. The future state value stream map (Figure A.3) is constructed based on the parameters identified in table2

TABLE 3

FUTURE STATE INFORMATION

Net available time per shift	450min (27000sec)
Process lead time	6 days
	6*450 = 2700 min
	2700*60 = 162000 sec
Value added time	9600sec (3hrs,20min)
Process cycle efficiency (PCE)	9600/162000 = 6%

5. **Control**: Most organisations around the world that are in business hinge their performances on return on investments (ROI). However, there are more composite measures which managers would use to evaluate their performance while implementing lean principles in their organisations [20 and 21].

"Without a single overall composite measure of performance, the individual is forced to rely upon his judgement as to whether increased efforts on one criterion improve overall performance, or whether there are maybe reductions in performance on other criterion which will outweigh the increase in the first. This is quite possible, for in any improvement situation many of these objectives may be contradictory to each other. [20 and 22]

This statement rings true in evaluating the success of a lean implementation. It has been well documented that financial results lag behind operational improvements in lean implementation.

A successful lean implementation will result in various operational and financial improvements. Operational improvements include;
   a. Higher quality and productivity
   b. Lower non productivity capacity
   c. Lower lead times and cycle times
   d. Higher process cycle efficiency (PCE)

Financial benefits include;
   a. Increased cash flow.
   b. Lower inventory level

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c. Lower costs.

In the course of this project, success is recorded in terms of reduction in lead time, cycle time, rework and idle times. While an increase is recorded in utilisation time and PCE.
A table of the improvement initiatives is presented in Table 3. In it we observed increase in PCE and utilisation time, while cycle time, lead time, rework and idle times are reduced.

TABLE 4
RESULTS

	Performance Measure	Current State	Future State	Improvements %
1.	Cycle time	26,400sec.	9,600sec.	36.4%
2.	Lead time	53days	6days	11.3%
3	Utilisation time	60%	100%	40%
4	Rework	40%	0%	100%
5	Idle time	21days	0days	0%
6	PCE	1.98%	6.0%	33%

5 RESULTS AND DISCUSSION

Educational institutions are facing more challenges than ever before. This is due largely to changing times in the human and technological growth in organisational management. Lean as management paradigm is applied mainly in manufacturing industries and this is because; little or no work has been done to achieve much aim in areas of education. However, with growing researches in this area of studies, efforts are being intensified through journal articles and seminar to institutionalise lean six sigma practice in the higher educational institutes across the globe. Such scholarly journal was referred to in several areas in this work. [1, 3, 4, 6, 7 and 23] gave a useful insight into the viability of lean application in the education sectors. The main aim of this work is to proffer an improvement process using lean six sigma process that will achieve a viable admission process for the ELITE state polytechnic. To achieve this, the writer has investigated into the main stream of the problems associated with the current admission process and used the qualitative method of data analysis, the DMAIC model for process improvement to solve the inherent problems. From the findings, it was investigated through the use of the questionnaires that 85% of respondents opined that admission process of the polytechnic is marred with waste and therefore need to be eliminated. Also from investigations, it was found that a lot of energy is wasted through transportations, information delivery methods and long distance travels by applicants. The result is that, cycle time and process lead times are very high. Rework and repetitions of functions created high incidence of waste in the process. But with the implementation of the lean six sigma principles in the management practice of the polytechnic, the result is a reduced process lead time, cycle time idle times and reworks. This has also resulted in an increase in the process utilisation time and the PCE. Though the cost of providing service was not evaluated, it is obvious that it is highly reduced when recommendations were fully applied, such as using the school's website to advertise, sales of admission forms, filling of admission forms and placing of admissions results are all carried out online. That means that the cost of transportation to the school and back will be highly reduced as most problems of the admission will be solved online.

6 CONCLUSION AND FUTURE WORK

This work has been a challenging one giving insight into the viability of lean six sigma applications in the administrations and management of educational institutions. The case study has the problem of inefficient and ineffective admission process which needs improvements and is exemplified from responses in question three. After implementation, test results show high improvement in the process. The improved process will give more value to the customers, who are the candidates seeking admission into the college. Therefore wealth and value are created since it boasts high morale for employees who may be entitled to some enjoyments from the growth.

The work done so far is a good milestone in contributing to the growth and development of lean sigma studies in applicability of lean six sigma practice in higher educational institutes and making its mark in areas of admission process redefinition. Though Radnor as cited in [10] argued that there is little doubt about the applicability of lean tools to the public sector, the writer has hitherto used lean six sigma tools and other practical illustrative works were carried out in this work to prove certain points which were never presented in any other lean six sigma studies in education. This is evident in the presenting of process flow charts, and the value stream maps, which may be entirely new in this development area of lean six sigma studies in the education sector.

Also, it could be argued, that from the evidence presented in the review shows that the idea of lean six sigma studies by this study will eventually receive full recognition and attention in a developing world like Nigeria, where the case study is situated. Further readings and researches can be carried out in areas such as the administrative process, process of collection of results and certificates, students' registrations and even library services. Finally the writer wishes to state that, since there could be elements of application of lean six sigma studies in some areas of management, but recognition may not be given to it as a lean practice as the subject of lean six sigma may be alien to such environment.

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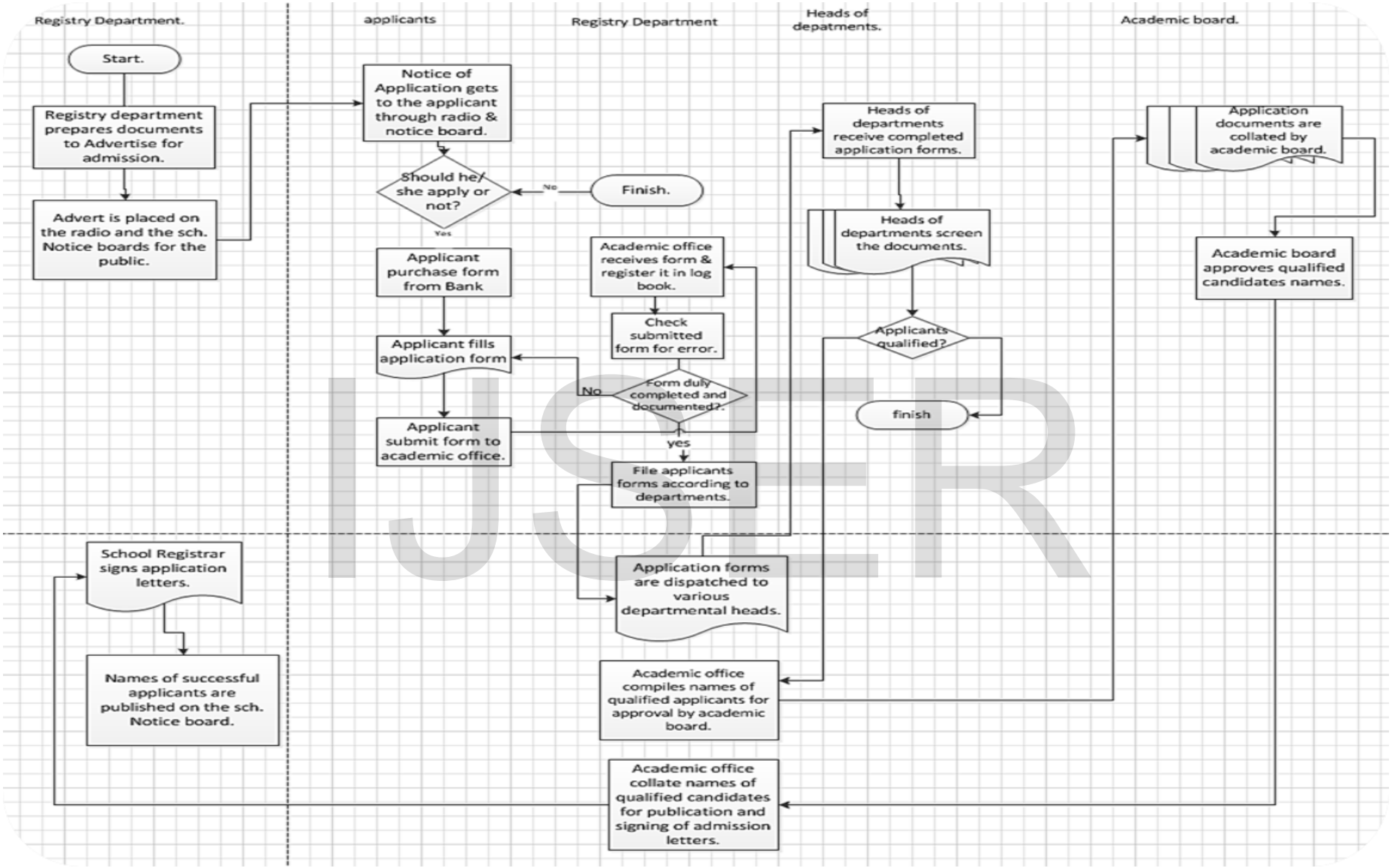

FIGURE A.1

ADMISSIONS PROCESS – CURRENT

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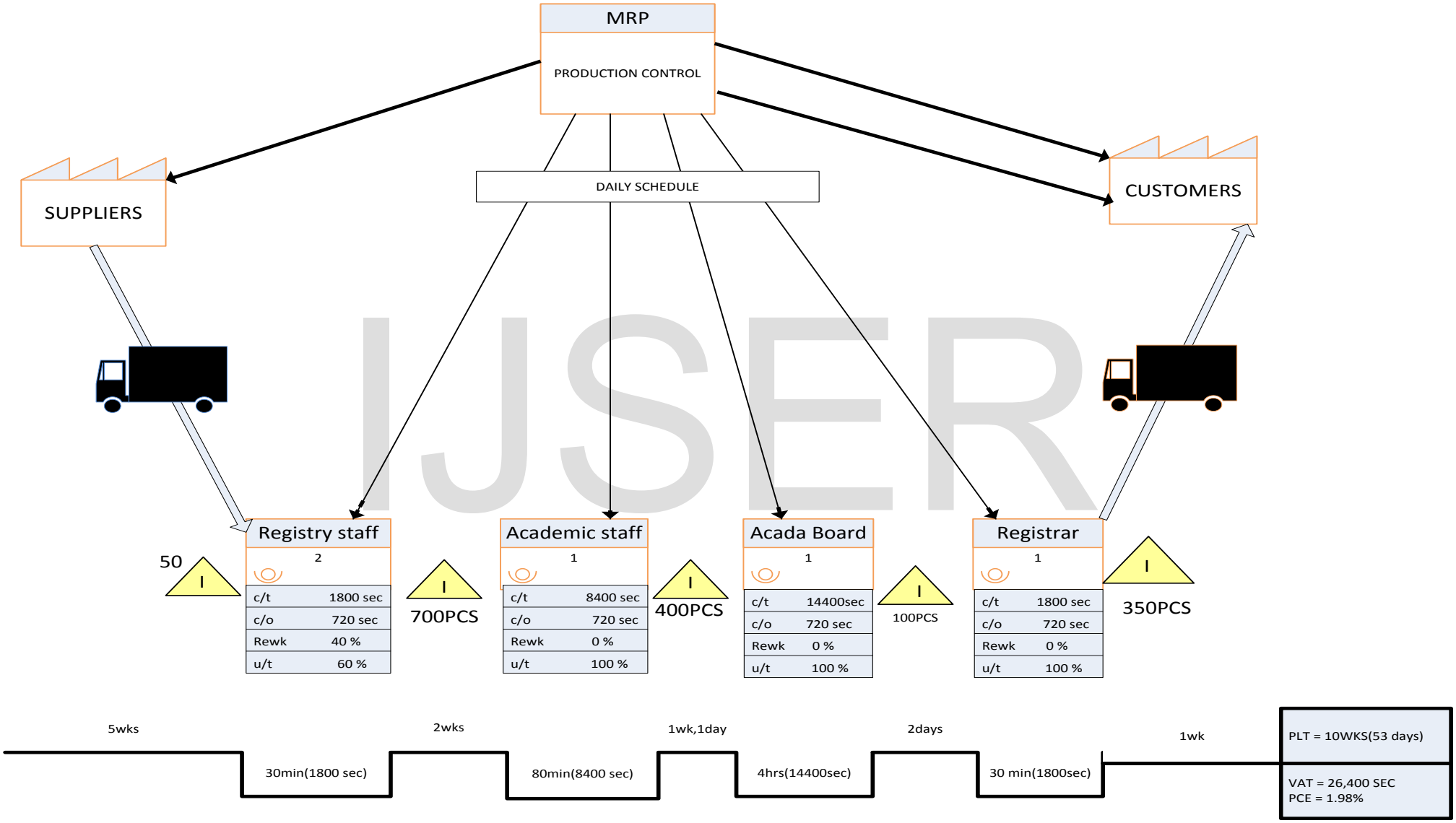

FIGURE A.2

VALUE STEAM MAP - CURRENT STATE

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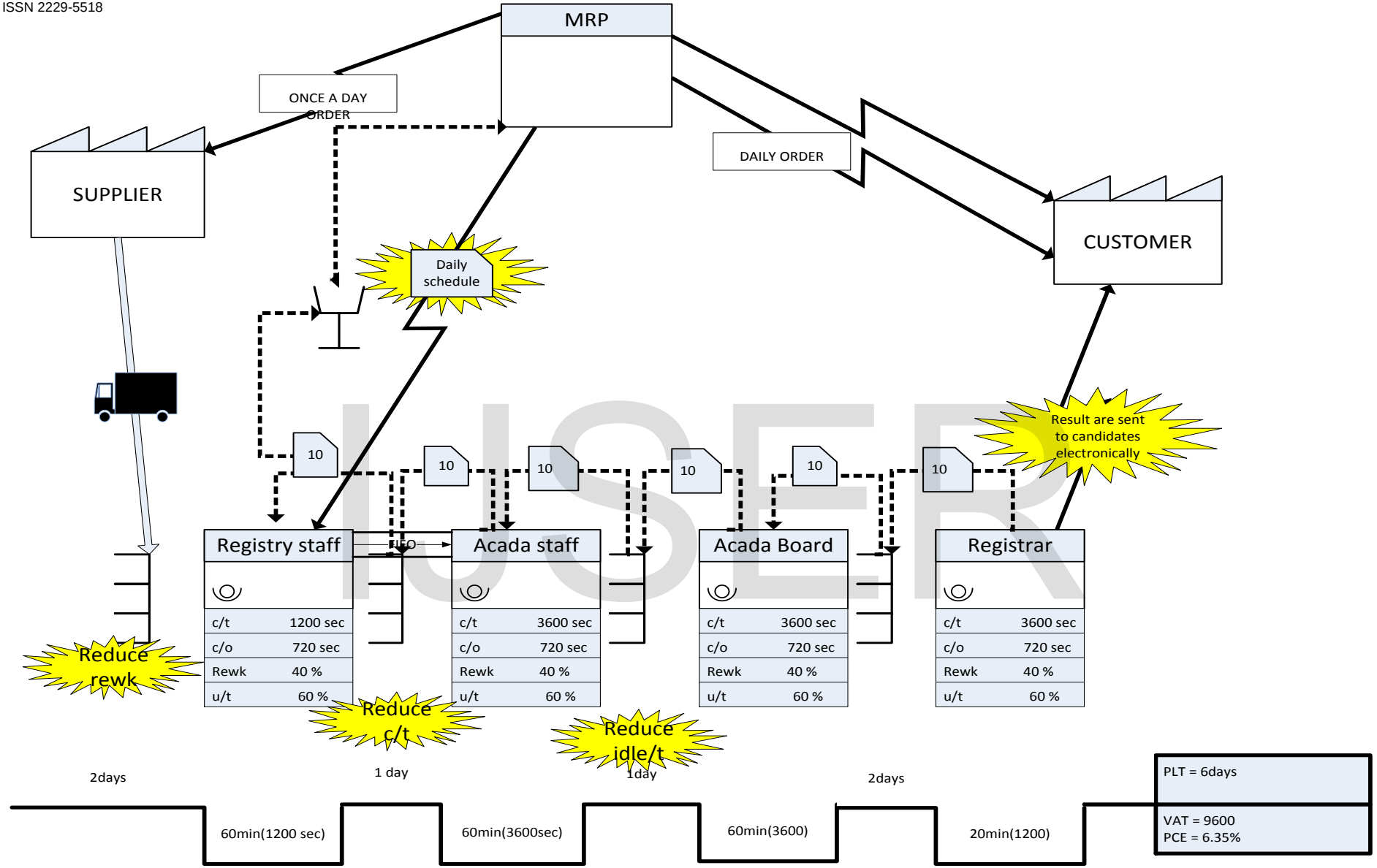

FIGUURE A.3

VALUE STEAM MAP - FUTURE STATE