Streamlining cross departmental interactions of back office processes in financial services

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ARTICLE INFO

Keywords:
Financial services
Reengineering Business Processes
Modelling
Discrete-Event Simulation
Lean Six Sigma

ABSTRACT

Due to the increased competitive environment in the retail banking industry, customer satisfaction and efficient back office processes have become more important.

Lean Six Sigma (LSS) is a management style that is focused on improving processes and increasing customer satisfaction. Discrete-Event Simulation (DES) is a method that is able to capture dynamic processes, and supports the analysis of processes and evaluation of alternative designs. The literature of an integrated approach of LSS and DES is scant. In this article the research question is answered: “When and how can Discrete-Event Simulation and Lean Six Sigma be integrated?”.

A case is researched, designing improvements to the closing process of current accounts at a retail bank, with an integrated approach of LSS and DES techniques. The case shows that DES can be properly used in LSS when a dynamic, interactive and complicated process is improved. Vice versa, LSS provides tools and dynamics that can support a DES study. These are: a strong focus on analyzing issues, involving stakeholders for generating alternative designs and the project management tools handed by LSS.

Future research should focus on the value of the integrated approach for: implementing designs, the effects of animation and the use of the integrated approach with a full project team.

1 Introduction

Developments in the retail banking industry have increased the pressure on profits. Firstly the Basel III regulations, demanding financial institutions to strengthen their resilience and to retain larger reserves (KPMG, 2010). Secondly, the introduction of a Single Euro Payments Area (SEPA) enables easier payments within the European Union and therefore increases competition within the European banking sector (BCG, 2009). This extended competitive environment and increased pressure on profits has increased the necessity to improve customer satisfaction and shape efficient business processes.

Lean Six Sigma (LSS) is a management style that is focused on improving processes and increasing customer satisfaction (Taghizadegan, 2006). Improving processes with LSS uses a strict improvement methodology (DMAIC), has a strong focus on metrics and demands a culture focused on customer satisfaction.

Discrete-Event Simulation (DES) is a method to mimic a process that is dynamic, interactive and complicated in a computerized model. With this computerized representation of a process analyses can be performed of current processes, evaluations can be conducted of alternative process designs of a process and an animation of a simulation can increase the understanding of a process, encourage the generation of alternative designs and can convince stakeholders of alternative designs (Pidd, 1996; Law, 2007).

LSS and DES have a couple of overlapping objectives. Despite this overlap of functions, there is scant attention given to the integration of DES and LSS approaches. In some cases this is logical, as not all processes are suitable for a DES approach. On the other hand, in more complex cases the integration seems to be more viable, but the literature is not broad on this topic.

The goal of this paper is to integrate the DES and LSS approaches, by addressing the question: “When and how can Discrete-Event Simulation and Lean Six Sigma be integrated?”. I will demonstrate that this can be done, by executing a case study, improving the closing process of current accounts within a large financial institution in the Netherlands.
Here, an approach is used that combines concepts from Design Science, Discrete-Event Simulation and Lean Six Sigma. By means of a literature review of the Lean Six Sigma concept, experiences during the case study and reflections during the research process with Lean Six Sigma consultants it is researched when and how concepts of LSS and DES can be integrated into each other.

This article is structured in the following manner. Section 2 provides a literature review of the Lean Six Sigma concept, the Discrete-Event Simulation concept and about earlier integrated uses of LSS and DES. Section 3 focuses on the subject of the case study, namely the closing process of current accounts. Section 4 aims at describing the conducted simulation project. Section 5 elaborates on the integration of LSS and DES within this case study. Section 6 reflects on the used research approach. Section 7 answers the research question and provides leads for future research.

2 Literature Review

In this section presents a literature review focused on the Lean Six Sigma concept, Discrete-Event Simulation and earlier combinations or integrations between these two, to provide a background on the LSS and DES concepts.

2.1 Lean Six Sigma

“Lean Six Sigma is the application of lean techniques to increase speed and reduce waste and process complexity, while employing processes to improve quality and focus on the voice of the customer.” (Brett and Queen, 2005: p.59). This implies that Lean Six Sigma is a combined approach for both Lean and Six Sigma.

Lean is a management philosophy that focuses on the continuous reduction of waste in business processes in the broadest sense. Lean is defined by Womack and Jones (1994) as the systematic removal of waste by all members of the organization from all areas of the values stream. Five basic principles of lean manufacturing are generally acknowledged (McCurry and McIvor, 2001):

- Understanding customer value, only the customer perception of value is important;
- Value stream analysis, understand what adds value for the customer;
- Flow, organize a continuous flow;
- Pull, carry out work at the moment it is demanded by the customer;
- Perfection, continuously improve processes until perfection is reached.

To achieve these five principles several methods are handed in the Lean literature. Examples are Kanban (a method to signal that production can start), Just-In-Time (finishing a product at the moment the product is needed), Kaizen (a methodology to design and implement improvements), 5S (a framework for keeping a clean working environment) and Poka Yoke (designing processes that cannot generate defects) (Andersson et al., 2006; Womack and Jones, 2003).

Six Sigma focuses on improving process capability and enhancing process throughput (Nave, 2002). The Six Sigma toolkit mainly contains statistical methods that enable organizations to understand fluctuations in a process. This allows them to identify the causes of problems, to improve the process by eliminating root causes, and controlling the process to make sure defects do not reappear (Pojasek, 2003).

To achieve the focus above Six Sigma uses five concepts. Lagun and Marklund (2005) describe this in ‘The Six Sigma Framework’, which is presented in Figure 1. This framework elaborates on the concepts with which the aims of Six Sigma are achieved.

![Figure 1: The Six Sigma Framework (Marklund & Laguna, 2005)](image)

This framework appoints the components of Six Sigma. Top management commitment provides the management interface required to ensure that the project remains on course relative to its objectives, or to change objectives if necessary given new information discovered by the project team (Pyzdek & Keller, 2010).

Training people to the Six Sigma philosophy is an important aspect to provide the critical link to customer satisfaction. This requires people to be trained to a ‘Green Belt’ or ‘Black Belt’, meaning different levels of Six Sigma education. The training is standardized (Keller, 2005).

Six Sigma prescribes a methodology for improving processes, namely the DMAIC cycle. Within every step of this cycle Six Sigma hands a broad toolkit to execute the methodology (Schroeder, 2008).

The measurement system of Six Sigma enables the strong focus on metrics of Six Sigma (Zh et al., 2008). The central issue is to make decision on data and to predict the effect of improvements quantitatively. This reduces the subjectivity and therefore the political influence on decision making (Brewer, 2004).

Last, a Six Sigma program requires stakeholder involvement, because without the active support and involvement an initiative will never take off (Pande et al., 2002).

The main differences between Lean and Six Sigma are presented in Table 1.
Approach of your enterprise—ultimately to improve Return on Invested

George et al. (2003: p.15) stated that: “Thus, achieving the goals reduction—requires both Lean and Six Sigma.” and Wedgewood steps are:

The Lean Six Sigma methodology has adopted the Six Sigma Sigma was integrated with Lean Enterprise methods (Lean (2006: p.7) states that: “Then companies realized that when Six

Secondary effects

Achieves business

Improve flow in

Performance

Tools

Advanced

statistical and analytical tools

Table 1: Concepts of Six Sigma and Lean; adopted from Andersson et al. (2006)

Concepts

Six Sigma

Lean

Theory

No defects

Remove waste

Process view

Reduce variation and improve processes

Improve flow in processes

Approach

Project management

Methods

Define, measure, analyze, improve, control

Understanding customer value, value stream analysis, flow, pull, perfection

Analytical tools

Tools

Advanced statistical and analytical tools

Primary Effects

Save money

Reduce lead time

Secondary effects

Achieves business goals and improves financial performance

Reduces inventory, increases productivity and customer satisfaction

Table 1: Concepts of Six Sigma and Lean; adopted from Andersson et al. (2006)

For each step LSS provides a toolkit. Besides this technical toolkit, Lean Six Sigma has a strong focus on establishing a culture within a company fully focused on customer satisfaction. Therefore Taghizadegan (2006) describes that a company that wants to implement Six Sigma should recognize the criteria of:

- top management engagement,
- committed to providing resources,
- company belief in Lean Six Sigma,
- and a commitment towards customer satisfaction.

2.2 Discrete-Event Simulation

Dynamic modelling is a method that is able to mimic business processes. This can represent the changes in behaviour that occur through time in a real system by means of a computerized model (Marklund and Laguna, 2005). Discrete-Event Simulation is the type of simulation that focuses on systems with discrete entities, for example bottles in a factory or closing requests in a back office (Schriber and Brunner, 1996).

Pidd (1996: p.223) has described a process is suitable for dynamic modelling if the process is:

- Dynamic, the behaviour varies through time;
- Interactive, different components interact with each other;
- Complicated; the number of interacting components is large.

In these cases a situation cannot be represented by a simple calculation or mathematical model. Discrete-Event Simulation can be used to:

- Predict the performance of changes to the system (Banks et al., 2010; Maria, 1997)
- Analyze a current complex process (Seila, 1995; Carson, 2005)
- Generate credibility for decision makers (Greasley, 2008)

2.3 Discrete-Event Simulation combined with Lean Six Sigma

This research aims at using an integrated approach of Lean Six Sigma and Discrete-Event Simulation. The literature on this topic is scant. Ferrin et al. (2005) have explored the fundamental relationships between Lean Sigma and simulation.

They state that a simulation is extremely compatible with the statistical rigor of Lean Six Sigma and that simulation can be used within the DMAIC cycle in the Measure, Analyze, Improve and Control phase. In the Measure phase simulation helps defining where one is relative to desired objectives. In the Analyze and Improve phase, simulation is the only available tool to deliver Lean Sigma accuracy for analyses and evaluations. And in the Control phase simulation can help prototyping in an SPC format.

El-Haik and Al-Aomar (2006) provide a roadmap for the use of Discrete-Event Simulation for improving processes with the DMAIC in their book ‘Simulation-based Lean Six Sigma and Design for Six Sigma’. To improve current processes they developed the 3S-LSS process flow, integrating Lean Six Sigma and Discrete-Event Simulation (see Figure 2).
3 Case: The closing process

Based on the literature review Discrete-Event Simulation is a proper tool to be used within a LSS program, because DES is able to analyze processes, evaluate alternative process designs and an animation can strengthen the generation of alternative designs and enhance stakeholder involvement.

As stated in the introduction this article aims at integrating DES in LSS. To achieve this, a case study is performed on designing improvements to the back office process of closing current accounts in the retail banking industry at a large retail bank in the Netherlands. The main issue of this process is the high throughput time of requests. This is a proper process for a case study with the intended research purpose, because it is suitable for DES and the LSS culture is percolated within the company.

The closing process is suitable for DES, because it is dynamic, interactive and complicated (Pidd, 1996).

The closing process is a complicated process due to the various products that are linked to a current account (e.g. savings accounts, shares depots or a credit card) and the different characteristics of an account (e.g. customers under curatorship, negative balances on accounts or youth account).

This requires a wide possibility of processes that have to be executed on an account and different interactions with other departments (e.g. the savings department).

Besides, the process is dynamic as processing times at different departments generate a certain stochastic dynamic within this process, because there is no priority for the closing of linked products, there are no clear service level agreements or interactions with the customer are required.

The Lean Six Sigma philosophy is percolated in the company culture, due to the strong customer adopted in the mission of the bank and the encouragement of the employees to be trained in LSS. Besides, prior to this case study improvements have been designed and implemented to the closing process by means of a LSS program.

4 The simulation study

The approach to conduct this research has been derived from three viewpoints on this problem.

Firstly, this concerns a design project. Therefore the ‘meta model’ of Herder and Stikkelman (2004) has been adopted as a starting point. This is a generic conceptual design framework and perceives design as “selecting an instance in the design space that meets the objectives and constraints”.

Secondly, the process is suitable for Discrete-Event Simulation. Therefore the stepwise approach of Law (2007) has been adopted to specify the steps of developing tests and executing tests with a DES model.

Thirdly, the DMAIC cycle of the Lean Six Sigma philosophy is a waterfall approach that is focused on designing improvements for existing processes (George et al., 2005). This methodology involves the analysis of issues in the current process and the generation of alternative designs due to the issues. This sequence of steps is adopted in the used research approach.

This leads to the approach presented in Figure 3.

4.1 Determine objectives and constraints

Objectives and constraints are the requirements that have to be optimized (objectives) and have to be met (constraints) by the designed improvements. Interviews, sessions and observations with the involved stakeholders are used to reveal these objectives and constraints.

This led to the following 7 requirements:

1. The throughput time of requests should be minimized.
2. The outburst rate of forms should be minimized.
3. The IT costs of the improvement should be minimized.
4. The efficiency (in terms of required number of human resources) should not decrease.
5. The risk of fraud in the process should not increase.
6. The accuracy (whether all linked products are closed) should not decrease.
7. The informing possibility (possibility to communicate with the customer) should not decrease.

4.2 Develop DES model

The development of a DES model is conducted by the collection and processing of real system data. By means of flow charts the closing process is mapped and data about the presence of characteristics and linked products, processing times of different operations and arrival rates is derived from current measurements, samples, interviews and data files. A simplified flowchart is described in Figure 4.
The chosen simulation tool to build the simulation model is Arena. This package uses the SIMAN simulation language and provides off-the-shelf building blocks. Arena has an animation function, which is helpful during the validation and in gaining commitment for the evaluations of alternative designs.

The DES model is validated and verified by various techniques described in Sargent (2004). The model includes an animation, which is presented in Figure 5. It is concluded that a valid simulation model is developed to test for the throughput time of forms and for the required number of fte that is necessary for the closing process (the efficiency of the process). Measuring the outburst rates of alternative designs turned out to be inaccurate.

4.3 Identify issues

The DES model of the current closing process enables the possibility to identify the causes for the lacking performance on throughput time. Issues have been derived from the process mappings and parameters, the seven wastes in processes (Ohno, 1988), waiting queues in the DES model and the sensitivity analysis which reveals the input variables that have a substantial influence on the process performance. These found issues have been mapped with LSS tools, namely cause and effect diagrams and value stream maps. This revealed the following issues for the high throughput time:

- the large number of interactions between departments to close coupled products;
- the unclear throughput time of closing a coupled product;
- the overnight batch processing of several operations;
- the serial closing of coupled products.

4.4 Develop alternative designs

Alternative designs for the closing process are developed by means of holding four brainstorm sessions. Each brainstorm session was organized around a different issue. In each session different involved stakeholders participated. The use of brainstorming is recommended in LSS, as this uses the expertise of people closely involved with the processes and creates a commitment towards the designed solutions (Davenport and Stoddard, 1994). Unfortunately, the animation could not be used for generating alternative designs.

The brainstorming sessions led to the following three alternative designs:

1. Provide the closing team access to the IT systems of linked products;
2. Provide a signal to the closing team when a linked product is closed;
3. Close linked products parallel.

4.5 Evaluate alternative designs

It is tested how the different alternative designs perform on the requirements. To test the throughput times and efficiency of the alternative designs experiments can be executed with the DES model, as the DES model is validated to do so. To test on the other five requirements expert interviews have been held or an analysis is made whether the ground causes for an objective or
Alternative designs have been influenced by an alternative design. To predict the performance of designs on these requirements more accurate, pilots might be necessary.

The predictions are summarized in Table 2.

<table>
<thead>
<tr>
<th>Alternative design</th>
<th>Av. TPT (days)</th>
<th>Efficiency (min/req)</th>
</tr>
</thead>
<tbody>
<tr>
<td>As-is</td>
<td>3.54</td>
<td>5.39</td>
</tr>
<tr>
<td>Access to systems</td>
<td>2.43</td>
<td>5.58</td>
</tr>
<tr>
<td>Active feedback</td>
<td>2.54</td>
<td>4.86</td>
</tr>
<tr>
<td>Parallel processing</td>
<td>3.52</td>
<td>5.20</td>
</tr>
<tr>
<td>Access and feedback</td>
<td>1.84</td>
<td>5.24</td>
</tr>
</tbody>
</table>

Table 2: Outcomes of the simulation experiments

4.6 Recommend a design

The experiments have provided clear insights in the performance of the alternative designs. This led to the following insights and recommendations.

Complicated back office processes (like the closing process) require transactions with other departments which cause an increased waiting time for requests. In some cases this waiting time is extended because it is not clear whether a request can be picked up again. This generates rework in a sense that requests have to be checked multiple times. Based on these evaluations of alternative designs the following design is proposed.

It is recommended to arrange one team that is fully concerned with the closing of current accounts, provide this team access to the IT systems of the departments of coupled products and allow them to execute the simple closings of coupled products.

This design enables the following benefits:

- This will decrease the number of interactions with other departments, and therefore the waiting times, substantially.
- This will decrease the needed amount of human resources, because there is more clarity about the requests that can be picked up, which eliminates rework. Besides, less transportation of forms is required.
- This will increase the overview on the working floor strongly, as there are less waiting request on the working floor.

5 Integration of DES and LSS

The conducted case study is performed with an approach that combines Discrete-Event Simulation and Lean Six Sigma. By means of: reflections of Lean Six Sigma consultants during the research process; reviewing literature; and experiences during the case study it is researched when and how LSS and DES can be integrated. This has led to possibilities for both to complement each other.

5.1 LSS adds value in DES

The different aims of both methods enable the possibility to complement each other. The conducted research shows that:

1. The strong focus on project management in the Define phase of the LSS road map, which is not present in DES approaches.
2. An analysis of issues, derived from the Analyze phase, provides a proper input to generate alternative designs.
3. LSS provides proper tools in the Improve phase, to generate alternative designs like brainstorming and a Kaizen.

Below the above aspects are discussed.

Focus on project management

Lean Six Sigma is an intensive method for process improvement fine-tuned to achieve implementation in businesses. The assimilation of project management tools from the Define stage, which ensure that improvements are implemented, strengthens the applicability of Lean Six Sigma in companies (George et al., 2005). These are for example: communication plans; project sponsors; team composition; and a broad toolkit for the Control stage to streamline the implementation. This supports the focus of LSS on businesses rather than on academics.

Described DES approaches, for example described in Law (2007), Maria (1997) and Carson (2005), have their magnitude mainly on the hard systems approach of the development of DES model and less on the project management of developing and using a DES model. A DES study within companies can be complemented with the project management tools handed by LSS like: a communication plan; describing how to communicate with the different stakeholders; the validation of financial benefits; and a project plan containing budget, schedule and milestones.

The addition of an analysis of issues

The addition of an analysis of issues during the research has been derived from the Analyze phase in the DMAIC methodology. In the DMAIC cycle the Analyze phase succeeds the Measure phase logically from the performed measurements. The Analyze stage, in its turn, reveals the issues in a process, which are a proper input for the design of improvements (in the Improve phase).

This sequence of activities (Analyze – Improve) can be adopted in a DES approach. The LSS tools that allow to map the issues are the Cause and effect diagram, Value stream mapping and the 7 wastes, which were suitable to map the issues forthcoming from the DES model.

Using issues and LSS tools to generate alternative designs

The DMAIC cycle prescribes the Improve phase succeeding the Analyze phase. Generation of alternative designs and evaluation of alternative designs are part of the Improve phase as well, which have been conducted in the research to the closing process. It turned out that brainstorming sessions, focused on the derived issues, were a proper tool to support the generation of alternative designs.

5.2 DES adds value in LSS

The following aspects are identified, for which DES adds value in LSS.

1. Issues within a dynamic, interactive and complex system can be analyzed by means of a DES model.
2. The effect of changes in dynamic, interactive and complex systems can be predicted in the Improve phase.
3. An animation can boost the generation of alternative designs in the Improve phase.

Below the above aspects are discussed.

Analyzing issues with a DES model

Performing an analysis with the DES model and the development of the DES model provide a proper insight in the issues in complex processes, namely:
For this particular research, DES modelling added value to evaluating solutions with DES. Therefore, it cannot be generalized that DES is suitable in every LSS program. On the other hand, the analyzed process has the characteristics that were described by Pidd (1996) to be suitable for a DES approach. Consequently, it cannot be generalized that DES is suitable in every LSS program. Usually, a DES simulation is able to test on only a selection of all set objectives. Even if a DES model predicts beneficial results on a subset of objectives, a pilot might be necessary to test whether a design meets the other requirements. For example, in the conducted research, a DES model is not able to predict the outcomes of an alternative design on the compatibility with the IT systems. This makes other types of evaluations inevitable. For example, to evaluate the risk of fraud, pilots have to be arranged.

**Stimulate the generation of alternative designs with an animation**

Often the added value of an animation is emphasized to encourage the generation of alternative designs (Law, 2007; Greasley, 2008), due to its capability to inform stakeholders about the dynamic properties of a process. The generation of alternative designs takes place in the Improve phase. Unfortunately, during the brainstorming sessions held within this research, the animation was not used, because the animation was hard to understand for stakeholders without deep knowledge of the problem. However, during face validation sessions with involved stakeholders the animation was used. From this, the generation of alternative designs originated automatically. For example a solution was proposed to arrange a team that takes care of all requests that are likely to have a high throughput time, due to the characteristics of the account. This team could contact the customer in advance.

**Discussion**

For the conducted case study a research approach that combines a generic conceptual framework for design, Discrete-Event Simulation and Lean Six Sigma has been used. This has led to the approach described in Figure 3. This turned out to be a proper approach for designing improvements to a complex back office process. At first sight, this is a hard systems approach, but soft system methods have been incorporated within the different steps. For example: setting requirements by stakeholder interviews and sessions; generating alternative designs in brainstorming sessions; and validating the DES model by face validation of involved stakeholders. The implementation of a design or improvement is not part of this approach and therefore the added value of the approach for the implementation of designs is not tested. On the other hand, the Six Sigma literature prescribes stakeholder involvement as an important component of a smooth implementation (Laguna & Marklund, 2005). The approach provides several leads for the involvement of stakeholders, which is likely to support a proper implementation of solutions. The use of simulation in the conducted case was beneficial. A main experience was that the deep process knowledge necessary to develop a DES model provided specific insights in the system behaviour. The DES model and the animation confirmed this behaviour. It is likely that for more complex processes it becomes less possible to predict the outcomes just from deep process insights and the DES model becomes necessary for making predictions.

**Conclusions and future research**

The goal of this paper was to integrate the DES approach and LSS approaches, by answering the question: *When and how can Discrete-Event Simulation and Lean Six Sigma be integrated?* This is conducted by combining the LSS and DES approach into one integrated approach and executing a case study with this approach. Reflections of LSS consultants during this process, a review of the LSS literature and experiences during the research process led to the following conclusions.

Discrete-Event Simulation is a tool that can be properly used within Lean Six Sigma, when a dynamic, interactive and complicated process is analyzed. In this case the Analyze phase can be supported by analyzing the DES model, the Improve phase can be enhanced by using animation during brainstorm sessions and the evaluation of alternative designs.

Vice-versa, Lean Six Sigma tools and concepts can support a Discrete-Event Simulation study which is concerned with various involved stakeholders and focused on improving existing processes. Firstly, LSS provides tools in the Define phase that support the management of the project. Secondly, in the Analyze phase LSS hands tools that enable the mapping of processes and concretely prescribes the analysis of issues to be a proper input for the generation of alternative designs. Thirdly, an animation can support this generation of alternative designs.

Future research should be performed on the following fields.

Firstly, the conducted case study did not concern a LSS program with a full project team. Using DES in a full LSS program provides insights in the use of a total LSS program and the required project management tools to do so. Secondly, the conducted case study did not involve an animation of the DES model during the generation of alternative designs. Literature prescribes this as a proper tool to understand business processes and encourage alternative design generation. Applying animation in the DMAIC Improve phase provides insight in the added value of using DES animation in the Improve phase. Thirdly, the research did not implement designs. Implementing designs that have been developed by using DES within LSS provide insight in the added value of DES for implementation designs. This can specifically focus on the increased conviction of stakeholders for solutions or the increased commitment to the improvement process due the involvement in the DES model development.

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