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Lean Six Sigma in financial services

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Abstract: Lean Thinking and Six Sigma are typically considered as separate approaches to process innovation, with complementary strengths. When combined as Lean Six Sigma, this approach provides a unified framework for systematically developing innovations. Lean Six Sigma can also bring about significant results and breakthrough improvements in financial services, as demonstrated with four case studies from Dutch multinational insurance companies. These cases demonstrate the importance of incremental innovations and show that there is room for improvement in the financial services industry. This article takes the integration of Lean Thinking and Six Sigma a step further by providing an integrated framework and a comprehensive roadmap for improvement.

Keywords: cost reduction; efficiency; improvement; innovation; quality management; service operations.

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1 Introduction

Financial services institutions face increasing competition, primarily because of globalisation. Companies have to compete with domestic competitors as well as with the best-in-class firms in a global context. Moreover, the competitors from abroad usually play the strategy game according to different rules, making it harder to respond effectively (Porter, 1980). Thus, to compete, it is imperative to improve operational efficiency and effectiveness. Improving operational efficiency and effectiveness includes quality improvement, cycle time reduction, productivity improvement, waste reduction and the elimination of rework. Financial services companies need to eliminate their operational inefficiencies, not just to gain competitive advantage, but even more fundamentally, to avoid competitive disadvantages and to stay in business (De Mast, 2006).

The methods for improving operational efficiency and effectiveness discussed in this paper are developed in the industry (as discussed below). Before explaining the use of these methods in financial services, it is worthwhile to discuss the differences between the industry and financial services. Without immediately analysing these differences in depth, we stipulate three important differences:

1. products are highly tangible; services and especially the service delivery process are less so
2. related to this, production flows are transparent in the industry and less transparent in services. The same holds for problems and irregularities
3. finally, the customer is much less involved in the production process in the industry than in services. Note that the interaction with the customer determines the quality of the service.

The fact that services are not always tangible and the process performance in services is not usually transparent could be seen as a impediment to apply Lean Six Sigma. The opposite is, in fact, true. Six Sigma offers advanced methods for making the process performance measurable and some of the Lean Thinking tools explicitly deal with making the production flows visible. Especially in an environment where visibility and transparency are new, this can create breakthroughs.

The other difference – the involvement of the customer and the importance of the service delivery process – between the industry and service also seems to be an impediment in applying Lean Six Sigma in services. We sometimes cling to pre-industrial notions about what service is and how it should be delivered. In fact, the type of innovations that have produced significant leaps in efficiency in the industrial environment have so far not been sufficiently applied to reduce the inefficiencies in the financial services sector, or many other service sectors for that matter (Levitt, 1976).

It should be no surprise that some people may object to the notion of industrialising financial services. They may even claim that it is impossible. However, industrialisation is essentially a conversion of artisan methods to more efficient, cost effective, standardised and streamlined systems for the delivery of products or services (Levitt, 1976; Heskett *et al.*, 1997). For example, a small step in the industrialisation of healthcare was to substitute an expensive medical specialist using a stethoscope with a lower-paid technician using an electrocardiogram. The use of the latter is not only cheaper, but far more accurate. This innovation has simultaneously improved quality and lowered the cost. The innovations in the financial industry can produce similar improvements. Indeed, in many cases, the industrialisation of service is beneficial to the quality of the service process as well as to the cost structure.

2 The approaches to process improvement

The manufacturing industry has invested in the systematic exploration of the opportunities for process improvement, cost reduction and efficiency improvement for many years. To do so, a large arsenal of tools and innovation approaches were deployed. Of these, Lean Thinking and Six Sigma are the two programmes that are currently popular (Stalk and Hout, 1990; Harry, 1997; Harry and Schroeder, 2000; George, 2003; Smith, 2003; Womack and Jones, 2003; Liker, 2004; De Koning and De Mast, 2006).

Both Lean Thinking and Six Sigma provide systematic approaches to facilitate the process of stimulating the innovations needed to improve the operational efficiencies and the quality. Lean Thinking emerged from the Japanese automobile industry after World War II (Ohno, 1988), but started receiving attention in the USA and Western Europe in the 1980s (Schonberger, 1982; Womack *et al.*, 1990). Similarly, Six Sigma was introduced in the 1980s at Motorola. However, this concept is the culmination of a series of developments in quality management that started in the early 1930s (Box and Bisgaard, 1987; Garvin, 1988; Snee, 2004). Indeed, it is building on a number of other approaches, such as Taylor's (1911) scientific management, with its focus on more efficient ways to perform tasks, Shewhart's (1931) approach to process control, Deming's (1986) management principles, Juran's (1989) trilogy and the Japanese approach to Total Quality Management (see Ishikawa and Lu, 1985; Imai, 1986).

Lean Thinking and Six Sigma have gone through parallel developments in recent years. Originally applied to a narrow range of industries – mostly manufacturing – both approaches are now also used widely in administration and service areas (Snee and Hoerl, 2004). In recognition of the fact that manufacturing today employs less than 10% of the US and European workforce and that service occupies a more prominent position in the economy, Lean Thinking and Six Sigma now seek to shed off the manufacturing legacy in the conceptual framework, toolkits and underlying methodology. A recent development is the integration of the two approaches (Hoerl, 2004; Snee and Hoerl, 2004), with an emphasis on the nonmanufacturing processes. In this article, we explore the integration of the two approaches with an application in financial services. Furthermore, we demonstrate with case studies that the resulting Lean Six Sigma approach is well-suited for application in the financial services organisations.

In this article, we outline the key principles of Lean Thinking and Six Sigma and briefly describe how to integrate the two approaches. This is followed by a discussion of our experience with this combined approach at two Dutch multinational insurance companies. The examples illustrate the complementary and synergetic benefits. The application of the integrated Lean Six Sigma approach can be beneficial in improving the quality of the financial services while simultaneously and significantly reducing the costs.

3 Lean Thinking

Although Schonberger (1982) and Hall (1983), among others, were early advocates, the proliferation of Lean Thinking in the Western world was prompted by the publication of Womack *et al*. (1990). They made a case for Lean Manufacturing by showing that the Japanese manufacturers in the automotive industry outperformed the US and Western European manufacturers dramatically. Partly because of this book, Lean Manufacturing became generally accepted in manufacturing in the Western world in the 1990s. More recently, it is also applied in the service environments (Womack and Jones, 2003).

It is not straightforward to characterise Lean (as it is often abbreviated) in a compact and comprehensive way, because it consists of a patchwork of diverse tools and techniques. This diversity and lack of coherence can be traced to Lean's development. It has grown in production processes, focusing on concrete problems. Most production processes suffer from diverse impediments that give rise to inefficiencies. The typical impediments are long changeover times, capacity bottlenecks and quality defects. Lean consists of a variety of practical, down-to-earth tools to solve or compensate for these impediments. These tools and solutions are highly industry-specific (see Zipkin, 1991).

Despite the diversity of the tools and techniques, there is a common denominator in all the Lean applications: the Lean applications aim to optimise the efficiency of the processes (see Wren, 2005; De Mast and Does, 2006). The typical strategy is to start mapping and modelling the processing times, throughput times and queue times, and mapping the redundancies and inefficiencies in the processes. After mapping these, the standard improvement models are applied to remove the redundancies and inefficiencies in order to decrease the processing times, throughput times and queue times. The most important improvement models are the following:

- *line balancing* – balancing and finetuning the processing capacity of each of the process steps in order to prevent both overcapacity and undercapacity
- *5S method* – an approach to make and keep the workspace well-organised and clean. This reduces the inefficiencies due to poor organisation
- *Single Minute Exchange of Dies (SMEDs) or rapid changeovers* – optimising the utilisation of the production resources by reducing the downtime of the production resource

- *visual management* – making the workflow and work pace visible to the employees, for instance, in the form of dashboards. This provides the employees with feedback on their performance and thus, helps them to improve their performance
- *cellular production* – collocating the process steps and rearranging the workspace to optimise it with respect to efficiency
- *pull systems* – a system in which the production or service delivery process only starts after a customer order. The aim is to reduce the inventory levels and overproduction
- *one-piece flow* – processing the work items one-by-one instead of as a batch, which helps to reduce the inventory levels and throughput time
- *critical path analysis* – the analysis of the interdependence of the process steps, with the aim to improve their mutual coordination and to reduce the total throughput time of the process
- *complexity reduction* – complexity is the number of different products and services and the number of processes. Complexity reduction reduces these numbers, with the aim to improve efficiency.

Details of these and other improvement models and the analysis tools used in the Lean approach can be found in the literature (Shingo, 1989; Liker 2004).

Lean's strength lies in providing a set of standard solutions to common problems and its customer focus. Suboptimisation is prevented by the use of the value stream map that ensures a focus on the entire value chain. However, Lean is short on the organisational infrastructures for managing the innovation efforts, deployment plans, analytical tools and quality control.

4 Six Sigma

Six Sigma is currently a popular and widely applied programme for quality improvement. It was originally developed as Motorola's internal quality management programme in 1987, but has since gained momentum after its adoption by General Electric in the mid-1990s (Harry and Schroeder, 2000; Snee and Hoerl, 2003). The programme can be characterised as a customer-driven approach with an analytic problem-solving framework, an emphasis on data-based decision-making, the use of project teams for problem-solving and by a focus on bottomline results (Bisgaard and Freiesleben, 2004).

Historically, Six Sigma is a direct descendant of Deming and Juran's systems for quality improvement. As in biological evolution, Six Sigma represents the 'survival of the fittest' in terms of the methods and approaches. It relies on a highly developed management system for its deployment. The improvements are carried out through carefully managed improvement projects. The project selection is typically based on a translation of the company strategy into operational goals (Snee and Hoerl, 2003). The project teams are deployed to solve problems of strategic importance. Six Sigma provides an organisational structure of project leaders and project owners. The project leaders are called Black Belts (BBs) and Green Belts (GBs). The management representatives, called Champions, play the role of project owner and act as liaisons to the executive management team.

Central to Six Sigma is the DMAIC problem-solving methodology. This problem-solving algorithm is essentially a modification of Deming's Plan Do Check Act (PDCA) cycle. The problems are tackled in five phases: Define (D), Measure (M), Analyse (A), Improve (I) and Control (C). In the Define phase, a problem is defined, evaluated and selected based on a cost/benefit analysis and a set of criteria determined by the upper management. Subsequently, in the Measure phase, the problem is translated into a measurable form by means of Critical-To-Quality (CTQ) characteristics. The data pertinent to the problem is assembled and a baseline study is conducted. In the Analyse phase, a thorough diagnosis of the current situation is carried out to identify the major factors that may potentially influence the CTQs. In this phase, statistical tools, ranging from simple to advanced, play a key role. In the Improve phase, the project team designs and implements the solutions or adjustments to the process to improve the performance of the CTQs. Finally, in the Control phase, process management and the control systems are developed and adjusted to assure that the improvements are sustainable. Furthermore, a post-intervention baseline study is conducted to assess the effectiveness of the proposed improvements. Each of the five phases (D, M, A, I and C) encompasses themselves in several steps. The roadmaps developed for each of the five phases guide the Six Sigma project leaders through the execution of the improvement projects (De Koning and De Mast, 2006).

To assure a successful launch and deployment of Six Sigma, an organisational infrastructure is established. A deployment plan for the strategically relevant projects ensures an alignment of the project goals with the long-term organisational objectives. Six Sigma uses a stage-gate approach (see Cooper, 1990) to project management, in which the projects are regularly monitored by the Champions and the appropriate actions are taken if a project appears to be drifting off from its schedule or original mission (charter) and scope. After having implemented a solution, attention is directed to quality assurance and control; the purpose of the Control phase is to keep the process from reverting back to past poor performance and, if unanticipated problems surface, to provide input for further improvement initiatives. Tools such as Statistical Process Control (SPC), mistake proofing, Failure Mode and Effects Analysis (FMEA) and control plans are used extensively in this phase (De Koning and De Mast, 2006).

A perceived weakness of Six Sigma is its complexity. In the case of simple problems with obvious and easy-to-implement solutions, a rigorous adherence to Six Sigma's DMAIC schedule may be considered as 'overkill' and inefficient (George, 2003). Although more enlightened versions of Six Sigma make provisions for quick fixes to simple problems, Six Sigma's instructional programmes typically do not discuss standard solutions to common problems, as is done in Lean. Another problem that can occur if Six Sigma is not carefully managed is that the projects may result in the suboptimisation of a particular process while failing to take into account the entire value chain or the overall organisational strategy. To avoid this, Six Sigma can benefit from the more holistic perspective provided by value stream mapping. Nevertheless, Six Sigma offers a structured, analytic and logically sound approach to problem-solving, as well as an organisational framework for its deployment.

5 The integration of Lean and Six Sigma

Given the shortcomings of both Lean and Six Sigma, it would appear that the ideal solution is to combine the two approaches, something a few practitioners tacitly have done for some time. We advocate an integrated framework for Lean Six Sigma, consisting of the following elements:

- *Organisation structure* – the organisational infrastructure is based on Six Sigma. This means that Lean Six Sigma uses a project organisation consisting of BBs, GBs and Champions. Moreover, the Lean Six Sigma initiative is managed as a programme and the project training and training programme are also copied from the Six Sigma approach.
- *Methodology* – the stepwise strategy for the projects of Six Sigma is used, containing the DMAIC phases (see Figure 1). Each of the DMAIC phases are broken down in two steps. For each step, a list of the end terms (the deliverable of the step) is defined and a prescription in which format they should be documented is provided. Note that our Lean Six Sigma methodology contains only eight steps instead of the traditional 12 steps of the Six Sigma methodology (cf. Harry, 1997). The Lean analysis tools and standard improvement models are embedded in this project approach, which offers an analysis of the project goals (Define and Measure phases), a diagnosis of the current process (Measure phase) and a good anchoring of the solutions (Control phase).
- *Tools and techniques* – in Lean Six Sigma, the toolboxes of both Six Sigma (see De Koning and De Mast, 2006) and Lean (see Section 2) are combined. Lean typically offers simple tools without much mathematical refinement. These tools are easy to apply and are effective in solving commonly encountered problems in the processes. The tools and techniques are incorporated in the stepwise strategy and help the BBs and GBs to attain intermediate results. Thus, one will find the value stream map as one of the tools used in DMAIC 3 (Diagnose the current process) and many of the standard solutions that Lean offers, in DMAIC 6 (Design improvement actions) and DMAIC 7 (Improve process control).
- *Concepts and classifications* – the concepts and classifications of both approaches are combined. From Six Sigma, terms such as CTQ and influence factors are taken, whereas Lean provides concepts such as takt time, critical path and waste.

Figure 1 The DMAIC approach of Lean Six Sigma (see online version for colours)

Define	
Measure	Define the CTQs Validate the measurement procedures
Analyse	Diagnose the current process Identify the potential influence factors
Improve	Establish the effect of the influence factors Design improvement actions
Control	Improve process control Close the project

The framework needed for implementing a full-blown Lean Six Sigma in financial services is actually quite similar to that in the industry and most other environments. The reader can consult De Mast *et al*. (2006) for details.

6 Lean Six Sigma projects at two Dutch financial companies

In the remainder of this article, we present four cases of Lean Six Sigma projects from two financial institutions. For proprietary reasons, some details have been left out, names have been removed and a few details were changed, but without misrepresenting the actual facts and experiences.

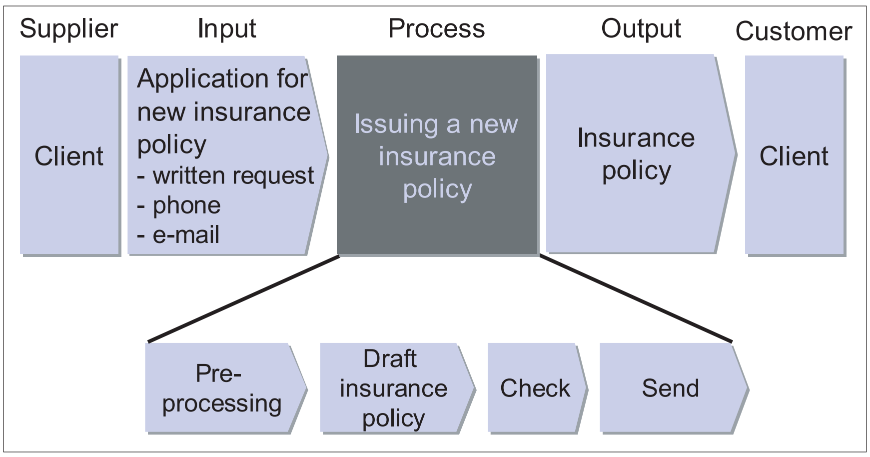
6.1 Example 1: insurance company A

Company A is a major insurance company in the Netherlands. It initiated Six Sigma and Lean as two separate programmes to improve quality and operational efficiency. Each effort had its own supporting organisational infrastructure of project leaders and project owners. In a later stage, the two approaches were merged. What remained resembled a standard Six Sigma deployment infrastructure. Both the Lean and Six Sigma deployments were project-based and so was the combined approach. Eventually, all the elements of the synthesised Lean Six Sigma approach outlined above were applied. To illustrate the value of the Lean Six Sigma approach, we now describe the two representative projects in more detail.

6.1.1 Project A1: the reduction of information requests

When issuing a new insurance policy, reliable and correct information is critically important. The process is described by the Supplier–Input–Process–Output–Customer (SIPOC) chart of Figure 2. The diagram shows the process's inputs and suppliers, as well as its outputs and customers. In addition, the main steps of the process are outlined.

Figure 2 The process description of the process of issuing new insurance policies (see online version for colours)



Specifically, an Information Request (IR) is issued if, during the preprocessing of an insurance policy (see Figure 2), it is discovered that a piece of information is missing. The process is pending until the required information is retrieved. The upper management felt that issuing IRs was a major source of problems. The project's mission was stated by management as:

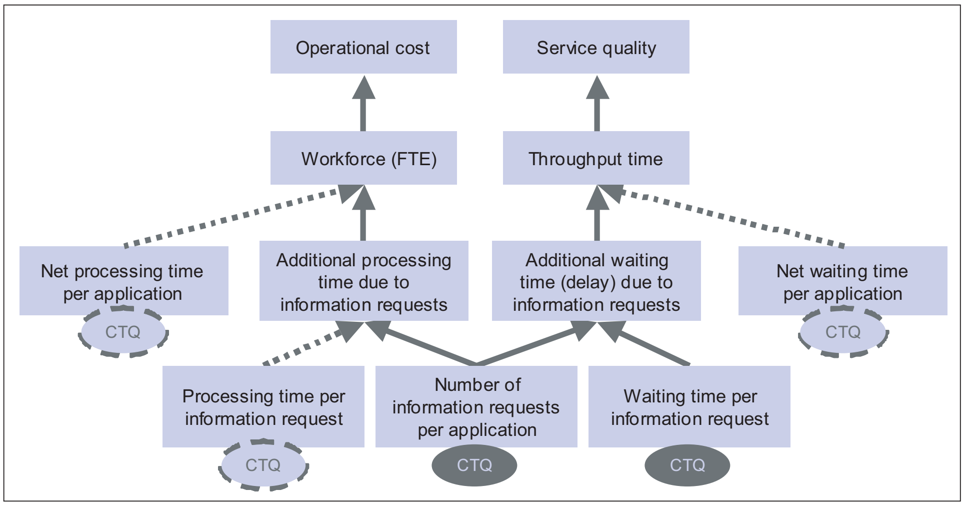
> "The requests for information creates all kinds of problems. The project should provide insight into the exact nature of the problem. Moreover, the project should reduce cost, reduce the number of information requests, and make the process more efficient and uniform."

The analysis of this somewhat obfuscated problem description nevertheless pinpointed a few key aspects of the IR process (see the tree diagram in Figure 3):

- the net processing time of an application increases the operational costs
- the additional processing time due to an IR drives up the operational costs
- the net waiting time per application increases the throughput time
- the additional waiting time due to an IR prolongs the throughput time
- the number of IRs per application drives up the operational costs.

Indeed, the last issue was at odds with the management's prior assumption. They thought that the total number of IRs was the relevant indicator. However, the diagnosis showed that the more relevant covariate was the number of IRs per application, a subtle but important difference.

Figure 3 The tree diagram for the process of issuing new insurance policies shows that the number of IRs per application and the waiting time per IR are the drivers of operational cost and service quality (see online version for colours)



To limit the size of the project, the team decided to leave the net application processing and waiting time outside the scope of the project. Thus, the BB team decided to focus its effort on the two following CTQs:

1 the number of IRs per application

2 the waiting time per IR.

Further analysis showed that the current process information system was misguided. Not only did the system record the irrelevant indicators, it also appeared that some indicators were subsequently misinterpreted. For example, the system showed the waiting time per IR. This was interpreted as the total waiting time per application due to the IRs. But in many cases, several IRs were needed to complete an application. Hence, this subtle distinction confused the decision-makers.

A process capability analysis showed that the average number of IRs per application was 5.5. The average waiting time per IR turned out to be 3.9 days. Therefore, the total waiting time due to the lack of information was approximately 21 days.

In the Analysis phase, experts were interviewed. In addition, 70 closed files and the 35 worst performing and 35 best-of-class cases were carefully reviewed and analysed. This review indicated that:

- many IRs had waiting times far longer than expected
- different teams used different procedures and there were even significant differences within the teams
- the information delivered by the clients was often incomplete, partly due to a lack of clear forms and procedures
- nobody knew the exact operational definitions of the existing performance measures, although these were supposed to guide management actions and decision-making.

Based on the team's diagnosis, the BB team decided to focus on standardising the process and establishing a system that provided better communication to the customer about what information is needed. The basic principles behind the redesigned process were:

- the frequency of communication and the communication channel was standardised
- a communication frequency of once per two weeks was made compulsory; the number of IRs sent to a customer should not exceed three
- only written communications with the customer should be allowed
- a checklist for the IRs for each type of insurance policy was provided
- a standardised template for written communications with the customers was developed.

Under the previous system, there was no quality control of the insurance policy issuing process. The new system incorporated a quality control system for monitoring the waiting time per IR, the number of IRs per application and the number of deviations from the Standard Operating Procedures (SOPs).

The responsibilities were clearly defined. The employees were instructed to work according to the new SOPs, use checklists and follow standard communications templates. Under the new system, the employee compliance with the new procedures is checked regularly by inspectors. The inspectors, in turn, are monitored by the team managers.

The results of this system change are promising so far. The average number of IRs per application has dropped from 5.5 to 2.6. This has resulted in the estimated annual savings of €260,000 (in terms of a reduction of the number of Full Time Equivalents (FTEs)). Moreover, 85% of the IRs are now processed according to the SOPs and the waiting time due to the IRs is less than six weeks. The average waiting time per IR has increased slightly from 3.9 to 4.8 days. This minor increase occurred because under the new system, the employees are allowed to send IRs only once every two weeks. However, the total number of IRs has dropped. Thus, the average total waiting time has dropped from 21.5 to 12.3 days.

6.1.2 Project A2: the reduction of the number of defects in the process of issuing new insurances

The objective of the second project was to decrease the high rate of errors in the process of issuing new insurance policies. The errors detected internally resulted in a significant amount of rework. This, in turn, resulted in a substantial increase in the operational costs. Moreover, the customers complained about the number of errors in the insurance policies. The two CTQs the team focused on were:

1. the percentage of errors in the insurance policies in the internal check
2. the percentage of errors in the insurance policies in the external check.

The external check is based on a sampling inspection of the insurance policies right before they are sent off to the clients. Company A already began to monitor these CTQs before the project started. Therefore, the BB team could quickly move through the Measure phase and focus on validating the measurement system. A Gage Repeatability and Reproducibility (Gage R&R) study showed that the measurement system was sufficiently accurate to proceed with the analysis. Subsequently, the process was subjected to a process capability analysis to provide a baseline before changes were made to the system. The percentages of the erroneous new insurance policies detected in the internal and external checks, measured over the year 2004, were 21.6% and 16.2%, respectively.

During the Analysis phase, the team discovered a number of causes for the high defect rates, including culture, the lack of knowledge of the process and the lack of accuracy. Some team members felt that the problem was rooted in culture. However, it is typically not a good idea to attack ‘culture’ head on. Culture change will usually follow as more tangible problems are dealt with. Thus, the team decided to focus on the knowledge of the process and accuracy. The effects of these two factors were established through the statistical analysis of historical data. A Pareto analysis showed that approximately 65% of the errors could be attributed to the lack of knowledge by the user of the software system. Furthermore, accuracy, a personality trait tested during the job selection process, turned out to be highly negatively correlated with the number of errors.

To gain insight into the ‘cultural’ or motivation issue, a quasi-experiment was designed and executed. The four work teams involved were randomly divided into two groups. The two teams from the first group, the control, were instructed to work as in the past. The other two teams from the second group were to be managed differently. For these teams, the most frequently-made errors during the day were discussed the next morning. A visual management system was developed, showing the number of errors. After a brief period, the results unequivocally showed that this second group performed much better than the control group.

Besides the discovery of several root causes, the data analysis refuted common myths and misconceptions. For example, much to the chagrin of some 'experts', the number of errors turned out to be independent of the productivity of the employees, their workload, the frequency of the interruptions and the incoming telephone calls.

Based on the identification of the root causes, the following remedies were implemented:

- a visual management system was introduced for all teams; a chart showing the number of errors per employee per week was provided for each team
- every Monday at a joint team meeting, the most frequent errors were discussed
- a senior employee was assigned as a mentor; he/she served as an expert with respect to system knowledge
- the team managers were provided weekly with reports about the errors made most frequently per employee; this was used as feedback and for coaching and appraisal purposes.

The immediate consequences of these simple changes were impressive. The percentage of errors in the internal check decreased to 8% and produced estimated savings of €180,000/year. Similarly, the errors in the external check decreased to 12%. The monetary benefit of this decrease is harder to assess. However, it is undoubtedly significant. We expect that the results will improve further after all improvements are fully implemented.

6.2 Example 2: insurance company B

The following examples are from another insurance firm, Company B. This company started with Lean Six Sigma much earlier, at a time when the two approaches were not fully integrated and Lean was not commonly used in financial services. The programme was introduced under the label of Six Sigma. Indeed, it was not realised at this early stage that some projects could be characterised as Lean projects as well. However, some of the problems would have been hard to solve with Lean tools only. The projects discussed below were tackled via the Six Sigma approach, but they implicitly applied typical Lean solutions.

6.2.1 Project B1: the transfer of pension rights

One of the pilot projects in Company B was focused on a problem that had haunted the organisation for a long time. In the Netherlands, many employees transfer their pension provision to insurance companies. However, if the employees change jobs, the pension rights may have to be transferred to other insurance companies. The process of transferring pension rights, called Pension Value Transfer (PVT), caused significant problems for Company B. The throughput times were excessive and the amount of time to process the PVT was high.

It was decided to dedicate a project to reduce the throughput and processing times of the PVTs. The management's stated purpose was to positively impact customer satisfaction and reduce the operational costs by decreasing the processing times. The selected CTQs were:

- the throughput time, defined as the time between the notification of a job change to the time the money was transferred to the new insurance company's account
- the processing time.

To measure the time, the sample files processed in the past year were randomly selected and the start and end dates were recorded. Because there were six teams processing the PVTs in parallel, the total sample was stratified over the teams. Specifically, each team randomly selected, tracked and recorded data from the files from their own work area. A subsequent baseline process capability study showed that although the process was in statistical control, the average throughput time was 186 days, *i.e.*, about six months. The average processing time was approximately 56 min per file.

The analysis of the data from this baseline study produced a number of interesting discoveries. Most prominently, there appeared to be significant differences between the teams. The best team processed the PVTs with an average throughput time of about 80 days. However, it took the worst team 315 days on average to process a PVT. Furthermore, the analysis showed that the 'official' procedure was not followed in 75% of the cases. Apparently, the employees were at liberty to choose how to process the PVTs. Moreover, it turned out that the work planners scheduled the PVTs that lacked the necessary information. This significantly increased the throughput time. Finally, a process map showed that inadequately addressed mail was routed along to *all* teams in a red box. The official process map did not mention this 'red box' process. However, it was found that the 'official' process had been amended long ago to accommodate unaddressed mail. The 'red box' process not only added extra processing time, but the BB team found that 80% of the 'red box' mail ultimately had to be returned to the sender, making this a complete waste of time.

Based on this diagnosis, the following improvement actions were developed around four main principles:

- a uniform SOP
- the 'line balancing' of the workload
- visual management and quality control based on the Statistical Process Control (SPC) principles
- unaddressed mail will immediately be returned to the sender.

The SOP implies a uniform approach to planning. The planners are made responsible for checking that all necessary information is available before any work is undertaken. Line balancing assures that the teams are assigned a balanced workload and their average throughput times are approximately the same. This change was intended to solve the problem of extreme outliers and would make the throughput time more predictable. Under the new system, the throughput times are monitored with SPC tools. The known causes for longer throughput times are recorded in an out-of-control-action report (cf. Does *et al*., 1999).

The improvement actions turned out to be very effective. At the time of writing, the average throughput time has decreased to 78 days was and still decreasing. Terminating the processing of unaddressed mail and reducing the processing time of the PVTs resulted in estimated savings of €130,000 annually.

6.2.2 Project B2: the rework of external communication

This project was focused on the communication between the external parties and a few selected departments of the insurance company dealing with the investments in stocks in the furniture, metal and catering industries. The idea was to sample a diverse range of departments dealing with different industries to pilot a new set of operating principles. The lessons learned could then be applied to the other departments working with other industries. The upper management was under the impression that the cost of the investment process was too high. Moreover, the customers of the produced information received too much erroneous communication.

The basic CTQs for this process were the processing times of making, checking and reworking external mailings. The processing times of the different process steps were measured with a stopwatch for a sample of the mailings. The percentage of erroneous mailing was selected as an additional CTQ. In recording the data, the BB team made a distinction between mailing processed by two different software Systems A and B. The latter was based on Microsoft Office and was quite flexible in use.

A process capability analysis showed that the average processing time for a mailing was 234 sec. However, the average was 17 sec for the mailings processed with System A and 343 sec, with System B. The average processing time for checking was 109 sec; there was no difference between systems, Systems A and B. The processing time for rework was 239 sec for System A and 137 sec for System B. The overall percentage of erroneous mailings was 10.5%. However, for System A, it was just 2.3%, whereas it was 14.6% with System B.

The project goal was to reduce the processing time as well as the percentage of erroneous mailings. Analysis showed that the three most important factors were:

1 the computer system used for processing the mail

2 the presence of adequate mailing templates

3 the industry group; the catering group did a significantly better job than the other groups.

Further diagnosis revealed that the first two factors were correlated; System A applied more and more accurate templates. These findings resulted in the following improvements. First, 35% of the mailings previously processed with System B were transferred to System A. To prevent the employees from having the convenience of continuing to work with System B, the templates were removed from System B. Second, the work and planning procedure used by the catering department were made the SOP and adopted by the furniture and metal departments. One of the differences between the departments was that catering used more user-friendly templates. This reduced the processing time and the percentage of erroneous mailings. Furthermore, to reduce the percentage of erroneous mailings, a number of templates were revised. Because of the lack of printer capacity, inappropriate printers were sometimes used. Thus, printer capacity was added. Finally, what may seem like a trivial matter but turned out to be a common mistake was the missing company logo on the mailings. As a preventive measure, the logo file was reconfigured on all the standard mailings. The overall annual savings of these actions were estimated to be approximately €175,000.

7 Conclusions

In today's global economy, financial services companies face fierce competition. Indeed, the competitive pressure is steadily growing. To remain competitive, the financial services companies must therefore continuously innovate and improve. As in any other business, the *status quo* is no longer an option.

The application of a wide spectrum of classical principles of industrialisation, including Lean and Six Sigma, offer useful solutions that can provide a better economy, greater efficiency and better quality in the financial services industry. Indeed, contrary to conventional wisdom, the industrialisation of services can simultaneously increase the quality and reduce the cost of service delivery.

There is often a debate about the relative importance of incremental versus breakthrough innovations. It should be obvious that we need both. This is not an either–or issue. Indeed, the two feed off each other. Breakthrough innovations bring forward whole new ideas that initially and typically are not all that economically viable. However, after several cycles of incremental innovations, the product or service becomes more robust, cheaper to produce and appeals to a larger population of customers. Thus, incremental innovations are typically and technically less than spectacular, but cumulatively significant economically (see Rosenberg, 1983).

Firms will typically have in place organisational infrastructures for promoting and managing breakthrough innovations. The Research and Development (R&D) department, with its plans, budget, management and controls, is the typical mechanism. Incremental innovations are, however, usually an organisational orphan. Most organisations have no organisational infrastructure in place for managing incremental innovations, let alone a plan and a budget. Lean Six Sigma, as described in this article, provides such a much-needed infrastructure.

Lean and Six Sigma are both approaches to facilitate systematic process innovation. They were both originally developed for manufacturing applications. However, they have complementary strengths. Synthesising these approaches provides an integrated programme combining the best of both. The combined Lean Six Sigma approach discussed in this article provides a useful framework for systematically developing and managing innovations that are particularly applicable in the financial services industry. Indeed, Lean Six Sigma integrates the organisational infrastructure and diagnosis and analysis capabilities of Six Sigma with Lean's tools and best-practice solutions for problems dealing with waste, rework, defects and unnecessary time consumption, problems we have found in great supply in the financial services industry.

The application of the Lean Six Sigma methodology in two Dutch insurance companies provides illustrations of the significant benefits that can be accomplished by this combined approach. There are some key lessons learned from these cases. First of all, it shows that neither Lean nor Six Sigma alone is best suited, but that the combination can provide practical and useful solutions for financial services. Secondly, it shows that Lean Six Sigma can bring about significant results and improvements. It helps organisations to survive, directly by creating improvements in the processes (cost reductions), but also indirectly by developing the organisational ability for innovation. Thirdly, despite past efforts, there is still room for significant operational improvements in the financial services industry. This industry has not yet reached the level of efficiency experienced by typical modern manufacturing operations. Indeed, many improvements made in the financial services environment are at the level of making sound process descriptions, standardising the best operating procedures and instituting uniform processes across different sites, groups and locations. Consequently, we see that Lean Six Sigma is applied somewhat differently in financial services than in the industry. Not in terms of the method used, but in the use of specific tools, the application diverges. The design of experiments, for instance, is hardly used in financial services. Value stream mapping, eliminating the standard forms of waste, introducing visual management, 5S, mistake proofing and line balancing are important improvement tools in financial services.

This all may appear simple, but it is typically not easy to implement such changes in organisations that are culturally not used to process innovation. However, it is highly effective and can be accomplished with the right organisational infrastructure. Indeed, by adopting initiatives similar to those described in this article, we believe that the results obtained by the Dutch insurance companies can be successfully replicated elsewhere in the future. Moreover, we believe that within the financial organisations that already apply Lean Six Sigma, the key to even greater success is managing their culture appropriately; the process innovation and improvement based on data should become second nature. If they succeed, the application of Lean Six Sigma will affect all organisational areas, from the back office to the staff to the front office and even in strategy-making.

References

Bisgaard, S. and Freiesleben, J. (2004) 'Six Sigma and the bottom line', *Quality Progress*, Vol. 37, No. 9, pp.57–62.

Box, G.E.P. and Bisgaard, S. (1987) 'The scientific context of quality improvement', *Quality Progress*, Vol. 20, No. 6, pp.54–61.

Cooper, R.G. (1990) 'Stage-gate systems: a new tool for managing new products', *Business Horizons*, Vol. 33, No. 3, pp.44–54.

De Koning, H. and De Mast, J. (2006) 'A rational reconstruction of Six Sigma's breakthrough cookbook', *International Journal of Quality and Reliability Management*, Vol. 23, No. 7, pp.766–787.

De Mast, J. (2006) 'Six Sigma and competitive advantage', *Total Quality Management and Business Excellence*, Vol. 17, No. 4, pp.455–465.

De Mast, J., Does, R. and De Koning, H. (2006) *Lean Six Sigma for Service and Healthcare*, Alphen aan de Rijn: Beaumont Quality Publications.

De Mast, J. and Does, R.J.M.M. (2006) 'Industrial statistics: a discipline with opportunities and challenges', *Statistica Neerlandica*, Vol. 60, No. 3, pp.1–13.

Deming, W.E. (1986) *Out of Crisis*, Cambridge, MA: MIT.

Does, R.J.M.M., Roes, K.C.B. and Trip, A. (1999) *Statistical Process Control in Industry*, Norwell, MA: Kluwer Academic.

Garvin, D.A. (1988) *Managing Quality: The Strategic and Competitive Edge*, New York: Free Press.

George, M.L. (2003) *Lean Six Sigma for Service*, New York: McGraw-Hill.

Hall, R.W. (1983) *Zero Inventories*, New York: McGraw-Hill.

Harry, M.J. (1997) *The Vision of Six Sigma*, 5th ed., Tri Star, Phoenix, Arizona.

Harry, M.J. and Schroeder, R. (2000) 'Six Sigma: the breakthrough management strategy revolutionizing the world's top corporations', *Currency Book*, New York: Doubleday.

Heskett, J.L., Sasser, W.E., Jr. and Schlesinger, L.A. (1997) *The Service Profit Chain*, New York: The Free Press.

Hoerl, R.W. (2004) 'One perspective on the future of Six Sigma', *Int. J. Six Sigma Competitive Advantage*, Vol. 1, No. 1, pp.112–119.

Imai, M. (1986) *Kaizen: The Key to Japan's Competitive Success*, New York: McGraw-Hill.

Ishikawa, K. and Lu, D.J. (1985) 'What is total quality control?', *The Japanese Way*, Englewood Cliffs, NJ: Prentice Hall.

Juran, J.M. (1989) *Juran on Leadership for Quality*, New York: The Free Press.

Levitt, T. (1976) 'The industrialization of service', *Harvard Business Review*, Vol. 54, No. 5, pp.63–74.

Liker, J.K. (2004) *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer*, New York: McGraw-Hill.

Ohno, T. (1988) *Toyota Production System*, New York: Productivity Press.

Porter, M. (1980) *Competitive Strategy – Techniques for Analyzing Industries and Competitors*, New York: The Free Press.

Rosenberg, N. (1983) *Inside the Black Box: Technology and Economics*, New York: Cambridge University Press.

Schonberger, R.J. (1982) *Japanese Manufacturing Techniques: Nine Hidden Lessons in Simplicity*, New York: Free Press.

Shewhart, W.A. (1931) *Economic Control of Quality of Manufactured Product*, Princeton: Van Nostrand Reinhold.

Shingo, S. (1989) *A Study of the Toyota Production System*, New York: Productivity Press.

Smith, B. (2003) 'Lean and Six Sigma – a one-two punch', *Quality Progress*, Vol. 22, No. 4, pp.37–41.

Snee, R.D. (2004) 'Six Sigma: the evolution of 100 years of business improvement methodology', *Int. J. Six Sigma and Competitive Advantage*, Vol. 1, No. 1, pp.4–20.

Snee, R.D. and Hoerl, R.W. (2003) *Leading Six Sigma: A Step-by-Step Guide Based on Experience with GE and Other Six Sigma Companies*, Upper Saddle River, NJ: Pearson Education.

Snee, R.D. and Hoerl, R.W. (2004) *Six Sigma Beyond the Factory Floor*, Upper Saddle River, NJ: Pearson Education.

Stalk, G. and Hout, T.M. (1990) *Competing Against Time*, New York: The Free Press.

Taylor, F. (1911) *The Principles of Scientific Management*, New York: Harper and Row.

Womack, J.P. and Jones, D.T. (2003) *Lean Thinking*, 2nd ed., New York: Free Press.

Womack, J.P., Jones, D.T. and Roos, D. (1990) *The Machine that Changed the World: The Story of Lean Production*, New York: Rawson Associates.

Wren, D.A. (2005) *History of Management Thought*, 5th ed., New York: John Wiley and Sons, Inc.

Zipkin, P.H. (1991) 'Does manufacturing need a JIT revolution?', *Harvard Business Review*, Vol. 69, No. 1, pp.40–50.