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Quality Engineering
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/lqen20

# Quality Quandaries: Shortening the Throughput Time of a Hospital's Billing Process

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Version of record first published: 27 Feb 2013.

To cite this article: Marit Schoonhoven , Caroline Lubbers & Ronald J. M. M. Does (2013): Quality Quandaries: Shortening the Throughput Time of a Hospital's Billing Process, Quality Engineering, 25:2, 188-193

To link to this article: http://dx.doi.org/10.1080/08982112.2012.758287

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*Quality Engineering*, 25:188–193, 2013
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ISSN: 0898-2112 print/1532-4222 online
DOI: 10.1080/08982112.2012.758287

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# Quality Quandaries: Shortening the Throughput Time of a Hospital's Billing Process

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## INTRODUCTION

In this column we present an application of the Lean Six Sigma methodology to a real-life problem, namely, shortening the throughput time of the billing process of a Dutch hospital. In The Netherlands, the health care system is growing toward a free-market system in which hospitals and other care providers can compete with each other in terms of price and quality. It is therefore becoming increasingly important for such organizations to operate on a more efficient basis and achieve a higher quality. As a consequence, the last decade has seen numerous health care organizations embrace a range of methods for improving business processes. The tools employed include total quality management (see, e.g., Hammer 1990), business process management (see, e.g., Van der Aalst and Van Hee 2004), theory of constraints (see, e.g., Davies et al. 2005), and Lean Six Sigma (see, e.g., De Mast et al. 2012). This article focuses on the application of Lean Six Sigma, a combination of the Six Sigma methodology and Lean best practices.

The Six Sigma methodology is not new because it is built on principles and methods that have proven themselves over time. The program was first applied in industry at Motorola, with the goal to improve product quality through process improvement. Subsequently, the program was adopted by other industrial companies and, since 2000, financial and health care organizations have also embraced the method. The success of the program can be attributed to the management framework the program provides, including roles and responsibilities, for organizations that strive for continuous improvement. Roles are defined for higher management, program management, project sponsors, project leaders, and team members. Improvement projects are led by people from the line organization, who are known as Green Belts and Black Belts. To facilitate project execution, Six Sigma offers a stepwise procedure consisting of successive stages during which the problem is smartly defined, measured, analyzed, improved, and controlled. In each stage, tools are provided in order to carry out the given step effectively. One important principle of Six Sigma is that project execution should make use of facts and data, so that the organization's most important problems are selected and solutions to these problems are effective.

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The Lean concept does not offer a Six Sigma type framework; rather, it can be seen as a collection of best practices (see, e.g., Womack et al. 1990). Together, the Six Sigma and Lean principles constitute a sound method, with the Six Sigma approach creating an effective organization and the Lean best practices approach suited to those projects that focus on improving efficiency.

The project described in this article provides a practical application of the Lean Six Sigma method to a hospital billing process: the lean principles generate information about the speed and continuity of the process flow, and the Six Sigma method analyzes relevant data to uncover the most time-consuming mistakes. The project was executed by a Black Belt at Beatrix Hospital, a member of Rivas Healthcare Group. Rivas Healthcare Group offers nursing care, maternity care, home care, and hospital care. The Beatrix Hospital itself is a 323-bed hospital employing a staff of 764. In 2011, the hospital had approximately 15,000 admissions, performed approximately 16,000 outpatient treatments, and received approximately 113,000 visits to its outpatient clinics, of which approximately 78,000 were first contacts.

The following five sections apply the Lean Six Sigma methodology to the project, following the Define–Measure–Analyze–Improve–Control(DMAIC) stages prescribed by that method. The final section offers some concluding remarks.

## DEFINE

A Lean Six Sigma organization enables substantial process improvements in the form of projects. The Lean Six Sigma method is not a strategy in itself; it can only be used to execute improvement projects whose goals are in line with a company's strategy. Essentially, higher management should look at available project ideas and select those that are likely to be a good investment of time and money because they address the right problems. After selecting a project, the project owner (the Champion in Lean Six Sigma terminology) and the Black Belt are appointed. The Black Belt draws up a contract setting out agreements on the project scope, including the process to be considered, the goals for the process, the business case, and the project team.

The project selected at Rivas concerned the throughput time of billing patient treatments in a hospital. A relatively long throughput time means a relatively long time between treatment and payment and therefore less income for the hospital. The background to the project was the introduction in January 2005 of a new financing system in The Netherlands based on so-called DBCs, which are similar to diagnosis-related groups. A DBC (Diagnose Behandeling Combinatie) is a set of treatments that a patient undergoes in a given period. A DBC uses four codes (type of care, request for care, diagnosis, treatment) to describe a patient's symptoms or ailment, how the patient was admitted to hospital, what diagnosis was made, and the intended treatment. A considerable portion of all DBCs (the "A-segment") is subject to a fixed price set by the Dutch Healthcare Authority. A smaller portion of DBCs fall under the B-segment and are negotiable. Currently, the B-segment is approximately 32% of total care at Rivas, but over time it is expected to increase to 70%. The purpose of the new financing system is to stimulate health care organizations to improve the quality and efficiency of their operations.

As at mid-2011, the average throughput time of the billing process at Beatrix Hospital was estimated to be 2 months. If we consider the A- and B-segments separately, we see that billing was more difficult for treatments in the B-segment, with the average throughput time of a B-segment treatment estimated at 4 months and that of an A-segment treatment at 2 months. Higher management felt that the process was no longer under control. Moreover, the B-segment is expected to grow, so the average throughput time of the billing process is also expected to grow. Given these developments, a Black Belt project was initiated in September 2011 to improve the billing process and decrease average throughput time by at least 2 weeks, resulting in cost savings of 120,000 euros.

The Black Belt selected was the Director of Rivas Facility Services, a department responsible for the financial, ICT (Information Communication Technology), and facility services used by Rivas. The Black Belt put together a team consisting of staff employed in the billing process. The team consisted of a financial consultant, the head of the hospital accounting department, and a hospital administrative coordinator. In the project contract, the Black Belt set out the time allocated to herself and her team members, the project goal (a 2-week reduction in throughput time), and the project scope (restricted to DBC billing). Furthermore, in the Define stage the Black

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Belt and her team produced a process description, from the moment a DBC is closed to the moment a bill is sent, with the intermediate steps as follows:

1. The attending physician checks the patient's plan of care—that is, the DBC listing the services provided to the patient—and gives authorization when all items have been recorded properly. The process is then continued by the hospital accounting department.
2. The system generates an automatic validation of the DBC to identify inconsistencies or mistakes. If the system indicates an inconsistency or mistake, the DBC is checked by a clerk. If the clerk does not know how to correct the mistake, the DBC is sent back to the attending physician.
3. At the same time every week, the system checks the availability of prices from insurers.
4. The available prices are assigned to the DBC and a bill is sent. If no prices are available, the system puts the DBC on hold.

A tool used in Lean Six Sigma to visually depict the process together with key decision points is the process flowchart. "Swim lanes" can be added to the flowchart to indicate which department is responsible for a certain step. A process flowchart with swim lanes for the billing process is depicted in Figure 1.

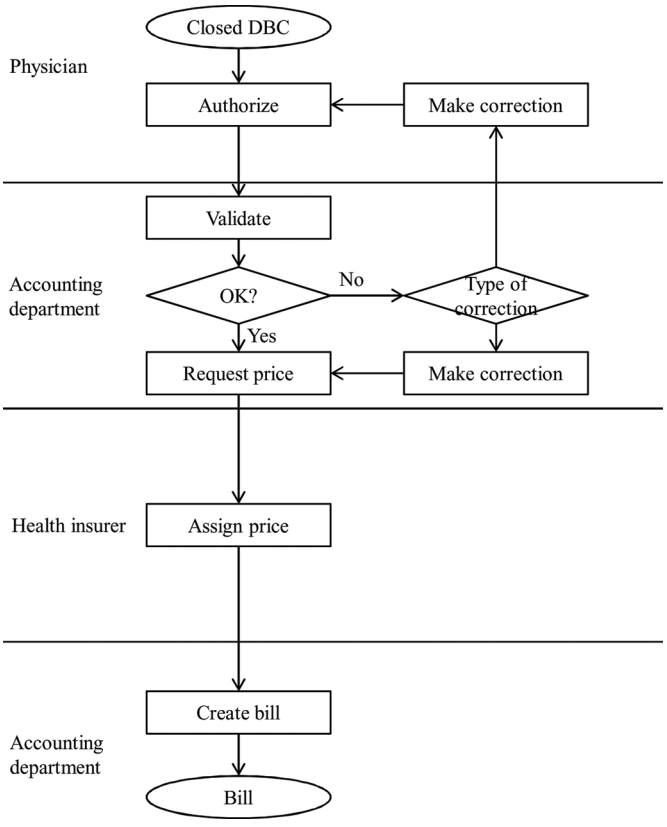


**FIGURE 1** **Flowchart of the billing process.**

## MEASURE

In the Define phase, the Black Belt sets goals, scopes the project, and selects a team. In the Measure stage, it is important to make goals quantifiable and measurable. In Lean Six Sigma terminology, quantifiable goals are called *critical to quality* (CTQs). These CTQs are the process metrics necessary in order to determine how well the process is performing at the start of the project and how much the process has improved when the project is closed. An aid to translating project goals into measurable CTQs is the CTQ flowdown. An article by Niemeijer et al. (2011) studied 271 improvement projects in health care organizations in The Netherlands, clustering the CTQs of projects with similar goals to arrive at nine generic CTQ flowdowns. Their method can help project leaders in the Define and Measure stages to define appropriate CTQs.

The goal of the Black Belt project in Beatrix Hospital was to reduce the time to revenue, which boils down to "throughput time" as the CTQ of the billing process. This CTQ was analyzed based on historical data from the registration process logging all crucial decision points in the system. The Black Belt chose to select all DBCs that were billed in August 2011.

The last step of the Measure stage is the validation of the data in the system; that is, ensuring that the data are correct. This was done by checking how the system logged billing data. For each step in the process, the Black Belt spoke to persons who were responsible for the given process step, checked how the data were entered into the system, and performed a number of test cases. The final data set was checked for completeness and unexpected values.

## ANALYZE

The ultimate goal of the Analyze stage is to diagnose the problem and produce a list of potential determinants of the problem. When analyzing the throughput times based on the data collected, the Black Belt found that the billing process had a

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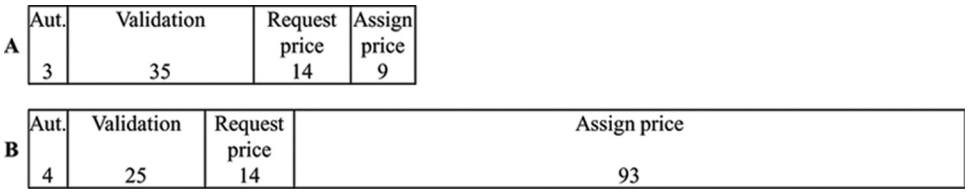


**FIGURE 2** **Gantt charts for the billing process.**

shorter throughput time for A-segment treatments than for B-segment treatments. Specifically, the average throughput time was 61 days for A-segment treatments and 136 days for B-segment treatments.

A well-known tool used for Lean Six Sigma projects is the Gantt chart (see, e.g., Slack et al. 2007). The Gantt chart was originally a project planning tool, but because the chart visually shows the duration of activities—the length of a bar in the chart represents time—we can employ the same concept to analyze process waiting times and make diagnoses. For the hospital billing project, Gantt charts were created for the A- and B-segment treatments separately to highlight the significant differences between their respective throughput times. These charts are depicted in Figure 2.

The length of a bar in a Gantt chart represents the waiting time associated with a given process step from completion of the previous process step up to completion of the given step. In the context of the hospital project, a bar represents the waiting time between completion of a DBC and authorization of that DBC by the attending physician.

The Gantt charts indicate that a significant amount of time was spent on validation and more so for the A- than for the B-segment bills because of the greater regulation of the A-segment (recall that B-segment prices are negotiable) and accompanying regulatory checks in the first part of the process. Some of the waiting times during the authorization stage were due to a lack of process monitoring: there was no clear reporting and no signaling system to trigger a clerical check. In addition, a proportion of bills (5% for each of the A- and B-segments) had to be corrected, further increasing throughput time.

The Gantt charts also showed that the DBCs in both the A- and B-segments required 14 days on average before the system ran the final step of assigning prices. The reason here was that bills were processed a standard 2 weeks after validation. These 2 weeks of waiting time constitute non-value-added time and, in a Lean process, should be excluded from the billing process. Finally, the Gantt charts showed that for the B-segments the average waiting time before assignment of the correct prices was extremely long, namely, 93 days. This was because the prices of some services had not yet been agreed upon with health care insurers.

With the diagnosis afforded by the Gantt method, a more accurate benefit analysis can be made. For the project at hand, the Black Belt took the waiting times in the Gantt charts and decided that it should be feasible to reduce the throughput time by at least one month for A-segment treatments and one month for B-segment treatments (the latter goal was less ambitious because the process of negotiating prices with insurers requires further investigation), resulting in financial benefits of 240,000 euros.

In the Analyze stage, the Black Belt used the diagnosis arrived at above to generate potential determinants of billing throughput time. We give a selection below of the potential determinants identified for each part of the process:

- Type of DBC (i.e., which types of DBC are not validated properly and have to be checked by an administrative clerk and perhaps by the attending physician as well).
- The frequency with which the administrative clerk and attending physician perform a correction of incorrectly validated DBCs.
- The date and frequency with which the system is run to price a treatment.
- The extent to which DBCs are covered by price agreements with health care insurers. The impact of these factors and resultant improvement actions were determined in the Improve stage.

## IMPROVE

The first step in the Improve stage is to determine the effects of the relevant determinants. The most

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**TABLE 1** Selected Determinants of Waiting Time in the Billing Process

| Process step | Determinant | Effect on A-segment in days | Effect on B-segment in days |
|---|---|---|---|
| Authorization | Initial registration mistakes | 4 | 3 |
| Validation | Frequency of checks and corrections | 21 | 6 |
| Price request | Date and frequency of system run | 13 | 13 |
| Price assignment | Agreements with insurers | 0 | 55 |

important factors are then selected and actions for process improvement are developed. For the billing process, the effects (i.e., waiting times) were derived from the historical data as presented in the Gantt charts. Table 1 summarizes the determinants selected for each process step and their impact on waiting times in the A- and B-segments.

As can be seen from Table 1, a very important determinant is the frequency with which registrations are checked and corrected. Interviews with clerical staff and attending physicians revealed a lack of reporting procedures, making it difficult to steer the process in the right direction. In order to monitor and manage the process more effectively, a reporting procedure will be implemented. Good reporting and clear agreements about maximum throughput times allowed for verification and any correction should reduce the validation step by 14 days. This improvement will be covered in the last stage of the project, namely, the Control stage.

Some mistakes in the process were made during the initial patient registration so that the corresponding DBC had to be corrected by a clerk and sometimes by the attending physician as well, leading to considerable frustration among staff. A quick scan (a Pareto analysis) by the Black Belt showed that the majority of mistakes could be attributed to a single cause. To address this, the Black Belt has written a brief guideline for the registration of patients by attending physicians and has implemented a number of system changes for certain DBCs so that physicians are alerted to any mistakes.

It also appeared that waiting times were partly due to the organization of the process flow. As noted earlier, batch processing causes hiccups in the process and therefore unnecessarily long waiting times. To ensure a smoother flow, it is important to run the validated DBCs earlier and more frequently. Rather than two weeks after validation, the system should run a daily request for prices.

Finally, a very important determinant of waiting times in the B-segment is the price agreements with health care insurers. Every year, new agreements are made with insurers and, in the past 5 years, this process did not begin until December, even though price agreements had to be reached by January of the following year. As a result, up-to-date prices were often not available in the first few months of the year, again leading to longer waiting times.

A tool in Lean Six Sigma that can lower throughput times is critical path analysis. This tool identifies steps that are not part of the critical path in a process; in other words, they can be taken care of at an earlier moment. In the hospital process, the price negotiation with insurers is one such step. Previously, negotiations did not begin until November or December but, in future, they will start in July with the aim of reaching agreement by January. The critical path for B-segment treatments will be 55 days shorter as a result.

## CONTROL

In the Control stage, the Black Belt draws up a plan to control the process, implements the improvement actions, and finally closes the project. As pointed out in the Improve stage, a key improvement to the billing process lies in the control of the process. The administrative staff and attending physicians have to manually correct DBCs without any clear system of reporting or signaling to help them see which DBCs are still open and without any agreements about maximum processing times. To improve this part of the process, the Black Belt has introduced a system of reporting whereby clerical staff can see which open DBCs have been in the system for the longest time and attending physicians can see which DBCs requiring correction have been waiting for the longest time. In both cases, the maximum allowable time is now five working days. The validation step must be completed within a week for DBCs not requiring corrections and within



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2 weeks for DBCs that do require correction. The head of the accounting department is responsible for monitoring the process.

The improvement and control actions proposed by the Black Belt were implemented in the first quarter of 2012. As a result, throughput times fell by one month on average, producing cost savings of 240,000 euros on a yearly basis. The improvement action requiring earlier price agreements with insurers could only partly be implemented in 2012 because negotiations had not begun early enough in the previous year. In 2012, negotiations began in August and the aim is to reach agreement for the most important DBCs by November. If this is achieved, then the throughput time for the B-segment will fall by a further 55 days in 2013, potentially generating further cost savings of 150,000 euros.

## CONCLUDING REMARKS

This article shows that Lean Six Sigma is a suitable method not only for manufacturing processes but for other key organization processes as well. Using best practices such as the Gantt chart and critical path analysis, supplemented by a sound project methodology, the Black Belt has been able to shorten the billing process by one month and has identified potential improvements for 2013 that could reduce the average waiting time for the assignment of prices in the B segment to 40 days. If these improvements materialize, then the total annual cost savings will be at least 390,000 euros.

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