

Accelerate DMAIC using Process Mining

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Abstract. Process mining is an accessible technique to visualize and analyze process variation and yield improvements. We experienced that Process Mining can help to overcome some of the barriers of the Six Sigma DMAIC cycle in improvement projects. This results in a significant acceleration to complete such a cycle.

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1 Introduction

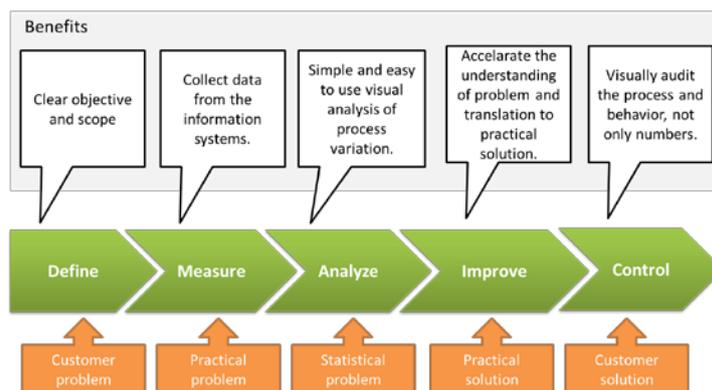
Recently we started using Process Mining as an additional technique to increase efficiency (cost side) and effectiveness (benefit side). In order to accomplish this, Lean Six Sigma was embraced as a philosophy to continuously improve and achieve permanent benefits. While reading the Volvo case we found a lot of similarities with our own experience when optimizing the IT Service Desk of the Rabobank. Sharing our knowledge and experience could help Volvo to use Process Mining as a tool to accelerate their improvements.

In our daily work we regularly encounter the limitations and difficulties in applying the DMAIC cycle to achieve actual improvements. DMAIC is a data-driven improvement cycle used for improving, optimizing and stabilizing business processes and designs. The DMAIC improvement cycle is one of the tools that drives Six Sigma projects. DMAIC is a structured and step-by-step framework, with the strength of underpinning root causes based on facts. However when applying this framework in practice one could encounter a number of pitfalls. First of all, the success of this framework depends on being able to collect the appropriate data. Secondly, measuring the data (for example a stopwatch or manual forms) is precious and expensive. This way of collecting data results in irritation and discussion about data quality, when drawing conclusions. Thirdly, special skills are required to perform the statistical analysis to identify the process variations. If root causes are identified based on these

statistical analysis techniques, the translation to practical solutions tends to be challenging. Main cause is the gap between the statistical analysis and the practice. This could result in difficulties when translating the statistical problem to a practical solution. We experienced that Process Mining aids to overcome some of these barriers. Still it remains important to carefully define and scope your improvement ambition. Collection of data can still be a complex undertaking. If certain preconditions are met and best practices are followed one can benefit from Process Mining by accelerating the implementation of improvements.

2 DMAIC with Process Mining

In this chapter we propose an approach based on the DMAIC framework combined with Process Mining tools and techniques. Figure 1 shows the DMAIC cycle composed of the phases: Define, Measure, Analyze, Improve and Control. Without the application of Process Mining it took 9-12 weeks on average to complete the DMAIC cycle. Application of Process Mining has reduced the cycle time to 4-6 weeks on average. In the following paragraphs we discuss our proposed approach for each phase in more detail.



2.1 Define

Whether or not Process Mining is applied in the following phases, it is important to define a clear and precise objective and scope. Setting an unrealistic objective or broad scope could result in lack of commitment and a diffuse focus. Based on the objective the improvement strategy can be determined, which is in line with the scope.

For example, one may choose to pick the low-hanging fruit or put the emphasis on resolving fundamental issues in the process or organization.

For the Volvo case we advise to investigate if incidents and problems can be prevented. Preventing incidents and problems is more cost effective than resolving them afterwards. However not all incidents or problems can be prevented, such that improving this process will be of value for the customer. The first question is: “Do we need to focus on the incident or problem management process?”. Both processes

could be candidate for improvement, but they also impact each other. For example, it's expected that improving the incident process will result in less problems. We advise to keep a clear focus and propose to focus on the incident management process first. The second question is: "What value is provided to the customer when resolving incidents?". We think customer satisfaction depends on two important aspects: quality of the solutions (first time right) and the lead time (time in which the solution was delivered). Due to absence of data supporting the customer quality of the solution we primarily focus on the lead time as the objective to create customer value. Third questions is: "What impacts the lead time?" We assume that the lead time is negatively impacted by a low 1st line resolution and the ping pong behavior between teams. Additionally one could focus on impacts of norms, such as priority and urgency. To illustrate the approach we kept the example simple as presented in figure 2.



2.2 Measure

Collecting the data is a challenging steps in the DMAIC cycle. Previously data was collected by performing measurements with stopwatches and manual forms. This resulted into a lot of discussion about the meaning and quality of the data. This is a distraction to draw actual conclusions from the data. One of the advantages of using Process Mining is that in many cases the data is already available in the information systems. People involved in the process understand the meaning of this data and quality of the data is part of their responsibility. This results in a better understanding of the meaning of the data and less discussion about the data quality. However certain preconditions have to be satisfied in order to take advantage of collecting data this way:

- Availability (to answer the questions)
- Access
- Format
- Quality
- Meaning

We assume that for the Volvo case these requirements were satisfied. However if one of these preconditions is not satisfied it tends to be more difficult to get a useful dataset for applying Process Mining. The following actions could help to resolve some of these issues:

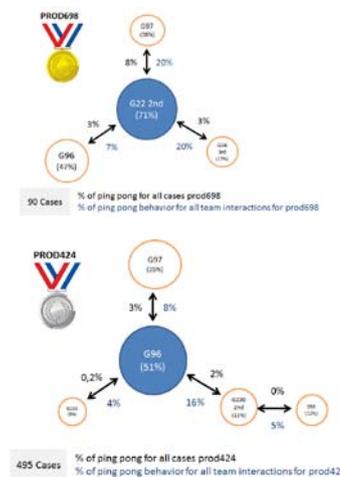
- adjusting the scope (back to the define phase)
- alternatives to collect data (drive system changes to collect transaction data)
- involvement and collaboration with: database specialist, data transformation specialist, database administrators, data owners, domain experts, etc.
- ...

2.3 Analyze

During the analysis phase the general performance of the defined measure is evaluated. The collected data is used to answer the questions and bottlenecks are identified. Detailed analysis on the bottlenecks are performed to determine the actual root causes of the bottleneck.

In case of Volvo we propose to perform a product based benchmark as a strategy to look for improvements with a high benefit potential. A snippet of the benchmark for lead time and impact of 1st line resolution is presented in the table 1. An example of the benchmark of ping pong behavior between teams for PROD698 and PROD424 is presented in figure 2a,b. We found Rapid Miner¹ is a useful tool to create these benchmarks in a short time.

	a. #Cases	b. #Teams	c. 1st line resolution	d. Average lead time (hour)	e. Lead time < 195,83	f. 1st line resolution > 80 %	g. Position
PROD424	459	111	72%	209,9	No	No	SILVER
PROD660	229	15	87%	229,2	No	Yes	
PROD383	205	7	94%	181,89	Yes	Yes	
PROD253	163	73	72%	181,94	Yes	No	
PROD698	90	23	22%	262,04	No	No	GOLD
PROD267	86	61	67%	118,7	Yes	No	
PROD494	71	33	62%	180,54	Yes	No	
PROD235	59	12	88%	101,68	Yes	Yes	
PROD716	58	9	93%	188,77	Yes	Yes	
PROD607	55	11	0%	223,07	No	No	BRONZE
...	
All products	4427	558	54%	195,83			

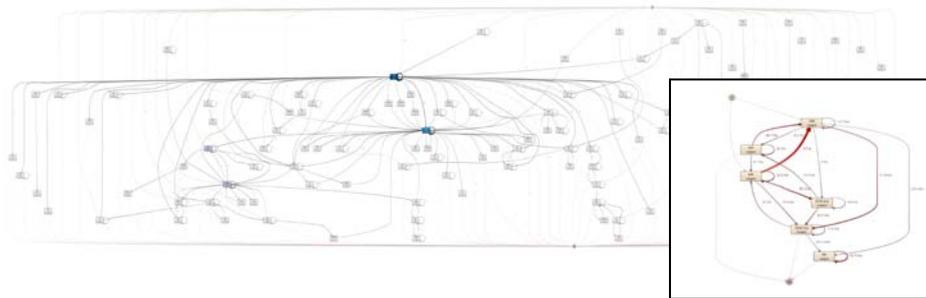


The benchmarks are used to trend the products, to select the product(s) with the best benefit potential. First, one needs to decide for which products the norms for the lead times are not satisfied (see column e. in table 1). The norm is not defined for the Volvo case, therefore we decided to use the average lead time as the norm. Second,

¹ <http://rapid-i.com>

one could determine if there is evidence that this norm was impacted by a low 1st line resolution (see column f. of table 1). We assumed a norm of 80% for the 1st line resolution. Based on this information a selection of the top 3 (gold, silver and bronze) can be made. In the selection process not only the quantitative, but also the qualitative aspects should be taken into account (value, time, budget, experience and knowledge of the teams).

In our experience every dataset has a story to tell. In order to determine the root causes and formulate measures for the selected top 3 products, the right people need to be involved to tell this story. The data can in some cases even help to select the people that need to be involved during the analysis in workshops. During these workshops the data is given further meaning in terms of root cause analysis. For example for PROD698 and PROD424 limited evidence could be found that the ping pong behavior between teams influences the lead time (see figure 2a,b). Process Mining tools like Disco² are able to visualize the process and it's variation to identify bottlenecks. This tool allows to investigate other factors that influence the lead time. For example we could explore the ping pong behavior between members of one team like within G22 2nd or G96. Figure 3 is a process map presenting the total process map of interaction between teams for PROD424 (high variation).



During workshops one is able to use the process map to zoom into the bottlenecks to underpin the root causes. Linking the bottleneck and the actual cases that were part of this bottleneck help to link the statistical problem to the practice. Questions during a workshop can directly be answered, such that these insight can be taken into consideration when measures are formulated. This enables that the members of the process can be involved in an early stage of analysis to give practical meaning to the analysis. We experienced that the Process Mining tool Disco also adds entertaining value, returning the fun by adding the practical value when performing complex statistical analysis.

² www.fluxicon.com

2.4 Improve

In the improve phase the root causes identified during analysis are translated into practical measures. For each measure the impact is determined and a potential benefit is estimated to underpin the investment.

In our experience there is a thin line between the analyze and improve phase. During the workshops we experienced that linking the root cause (statistical problem) directly to a measure (practical solution) is an important driver for the success of the implementation. Avoid endless discussion about statistical facts and figures, which are often difficult to link to practical solutions. Instead focus on drawing conclusions based on the power of visualization and linking this to practical examples. In this way one can speed up the process of formulating actions that will drive the implementation of the actual improvements forward.

2.5 Control

The purpose of this step is to sustain the benefits. Replicating the benchmark can be used to monitor the improvement measures and deep analysis with Disco supports further analysis to understand the impact of the change. Less effort is required to data collection, as this is performed in a similar way as described in the measurement phase. Challenging is how to keep people motivated to sustain the implemented measures. In our opinion Process Mining can be used in a fun way to perform audits and continue to challenge people to give their best effort.

3 Summary

Based on our experience with Process Mining in a practical context, we propose an approach to apply Process Mining in a structured and step-by-step way to improve business processes. The basis for this approach is the DMAIC framework from the Six Sigma toolkit. DMAIC is a data-driven improvement cycle used for improving, optimizing and stabilizing business processes and designs. The following phases are part of this cycle: define, measure, analyze, improve and control. For each phase we have presented best practices to use Process Mining as a tool to accelerate the completion of the DMAIC cycle.

Whether or not Process Mining is applied, defining a clear and precise objective and scope is an important first step.

Taking advantage of existing data extracted from the information systems is one of the advantages when applying Process Mining. This speeds up the process of measurement significant, resulting in less discussion about the quality of the collected data. However certain preconditions must be satisfied in order to take advantage of the data from the information systems.

During the analysis stage we proposed to use benchmarks to trend products, to give direction toward the right causes. Further analysis can be performed in order to

underpin the root causes. Due to the ease of Process Mining tools such as Disco it is possible to involve the stakeholders in an early stage of analysis.

In our workshops we have experienced that linking the identified root causes (statistical problem) directly to a measure (practical solution) is an important success factor for the implementation.

Tools like Disco also add entertaining value, making complex analysis fun and keen people motivated by challenging them to give their best effort.

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