LEAN SIX SIGMA PROJECT CASE STUDY

IMPROVING THE CUSTOMER FLOW AT POINT OF SALE FOR THE PUBLIC SWIMMING POOLS IN BASEL CITY

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PROJECT REPORT

BUSINESS CASE

The city of Basel operates three public outdoor pools with locations in St. Jakob, Bachgraben and Eglisee. At all three locations, it was found that the queue in front of the point of sale is often over 10 meters long on hot summer days and customers have to wait up to 40 minutes. A first clue is customer comments on social media, which indicate that it takes up to 10 minutes for a customer to buy a season ticket. In the meantime, the other customers are waiting in the queue behind this customer until the process for a season ticket has been completed. Other customers complain that the automatic revolving door does not always work for customers with an existing ticket and that only one of two sales outlets is staffed by a cashier. In 2017, the canton of Basel counted an average of 184 903 entries per season in the St. Jakob garden pool, which is continuously decreasing (comp. Schwald, 2019) [1] The single entrance prices is SFr. 7.50 per adult and the season subscription is SFr. 90.- for adults with citizenship Basel city and SFr. 120.- for foreign adults. (comp. Canton of Basel city, 2020) A Lean Six Sigma project aims to determine the reasons for the long waiting and processing times and to use the knowledge to define point of sale processes with a tact time of 1 to maximum of 2 minutes.

[1] The original text was in German and was translated in English from Author

BRIEFLY DESCRIPTION OF DMAIC STEPS

DMAIC STEPS

The fully project is related to the DMAIC framework of Lean Six Sigma, which means using a cycle with the steps Define, Measure, Analysis, Improve and Control one after one, where the project always start with the Define phase and following each step after other. But some time it is necessary to going a step back, when during a project some new conclusions are made and some unexpected cause of problems discovered. Lean Six Sigma uses common tools from quality management, statistics and continuous improvement. The main point are measurable metrics and statistical process controlling within 6 Sigma Standard Deviation on each side of the process mean if the samples are normal distributed, which is covering 99.9997% of all variations in a process and only produce 3.4 defects per million opportunities. But in several cases 6 Sigma are too expensive for companies, so it is possible to work only with 3 or 4 Sigma. In high tech industry like aeroplane production and maintenance, medical device industry or as another example surgery in a hospital needs 6 Sigma processes. But for a bicycle manufacturer or a restaurant 6 Sigma are too expensive. So which level of Six Sigma are used is depend on quality expectations, the cost for the processes is expected to pay, legal requirements and customer expectations.
The topic Lean Six Sigma include also the word Lean which focus more on Wastes and Delays in a process to reduce the non-value added steps, but Six Sigma focus on the high quality, control and stable process at the output with the aim of a near

perfect process. The several steps in a Lean Six Sigma project and environment and how it used in this project are described as follows.

DEFINE PHASE

SIPOC

The focus of this project lies in the point-of-sale process, because we want to improve the customer flow there by reducing the cycle time per customer. To get a better understanding between the relationships between process inputs and outputs, a SIPOC chart was created. The abbreviation SIPOC means S for the supplier, I for the inputs, P for the process, O for the outputs and C for the customers. The SIPOC chart gives us a rough overview of a process. A brief data summary of the diagram designed in this project is listed below.

S: Suppliers for Technical Equipment of Point of Sale and entrance system, Bank, Cashiers and Customers

I: Programming codes, interfaces, digital or cash payments, Customer photo and passport or ID card

P: Customer requests and questions, Entrance tickets, payments and receipts

O: Daily tickets, Group tickets, Season tickets, Receipts, Information, Problems, return cash change

C: Bank, Single Visitor, Groups, Schools, Families, Tenants for rental cabins

XY MATRIX

An XY matrix was created following the SIPOC diagram. In this matrix, the inputs were rated as X, which most influenced the process, and the outputs as Y, which were most affected by these inputs. The importance of Y was rated from 1 to 10 each, with 1 being the lowest and 10 being the highest. The impact of all inputs on each output was also rated with points from 1 to 10. A matrix was created in which the inputs X are in a column on the left and the outputs Y in a horizontal line above. Each input was now multiplied by the output in the matrix and the value is written into the corresponding cell. At the end, the buzzer of the line from each input is added and written in the column on the right as Total. The input with the highest score in Total influences the process outputs the most. The results are displayed below.

	LEVEL OF IMPORTANCE OF THE OUTPUT VARIABLES (Y)				
	Customer Satisfaction	Recommendation	Customer Loyalty	Turnover	
INPUTS (X)	10	7	7	10	TOTAL
Waiting Time in queue	100	70	56	100	326
Informations	60	42	42	80	224
Entrance Prices	50	35	56	100	241
Opening Hours	100	42	70	100	312

Table 1 XY Matrix

The biggest impact in terms of the XY matrix is the "Waiting Time in queue" and second "Opening Hours". Therefore, the focus of this project is to focus on the main impacts "Waiting Time in queue", found the root cause of the problem and fixed it.

VOC (VOICE OF CUSTOMERS)

A short survey with 10 customers was made to understand the Voice of Customers and learn what the customer expectations is and what them let make satisfied. Every process should be customer-focused that we serve what is expected. Otherwise a service or product is offered who not meet the expected customer needs with consequences of bad selling and reputations, lost turnover and customers as a result. The customers answered the questions and remarked it with disagree - 2, disagree - 1, neutral 0, agree +1 or very agree +2, furthermore there was three free text fields for an opened recommendation.

The most important results where customers were very disagree -2 are:

1. I get all information about tickets, prices, etc. before I pass the point of sale
2. The waiting time in the queue behind the point of sale process is acceptable

The most important results where customers were disagree -1 are:

3. The point of sale process is better than in other swimming pools
4. To buy a season ticket at the point of sale it is quick and easy

So after this short survey it is clear that this project must have a focus on analysing and optimizing the waiting time in the queue, better information to the customers and improve the process to buy a season ticket. This survey is closely related to our analysis of the social media comments which is mentioned in the business case.

CTQ (CRITICAL TO QUALITY)

Related to the VOICE OF CUSTOMERS survey we can conclude the CRITICAL TO QUALITY is:

1. Waiting Time in the Queue
2. Information about tickets, prices, occasions and opening hours
3. Entrance prices
4. Opening hours

So this four points will be critical to quality, which means if they not reach customer expectations, the customers will say it is bad quality and they are unsatisfied.

COPQ (COST OF POOR QUALITY)

When the quality fails to meet customer expectations, there is a cost to the organization. It is a very real cost and often underestimated or ignored completely. In a COST OF POOR QUALITY calculation we give the waste an amount in money. While there are no precise answers to the questions that follows, it is done the best to make reasonable estimates. In this project the following key data are estimated for the calculation:

1. Average selling price per single ticket for adults: SFr. 7.50
2. 10% of customers not enter the public swimming pools when they realize a long waiting queue
3. 554'709 estimated single tickets are sold by year in all three locations together
4. 5% of the customers do they business elsewhere in the future

The result COST OF POOR QUALITY as an estimation is: 624'047.- Swiss Francs because of poor quality, which is related to not hear the VOICE OF CUSTOMERS and fails to meet customer expected quality which is mentioned in CRITICAL TO QUALITY. In other words, if we meet customer expectations we can earn 624'047.- Swiss Francs more as a sum for all three locations (St. Jakob, Eglisee and Bachgraben).

MEASURE PHASE

MEASURING CRITERIAS

In the measure phase continuous or discrete data was collected in order to draw conclusions and insights in the further analyse phase. The measuring criteria was to measure the tact time in seconds which starts when a customer enter the point of sale and leave it with a service. But also remarks were done which service was provided, how long a waiting queue is at which time, when the cash system, digital payment or revolving door doesn't work and how long it goes until a problem was fixed. The decision was made to work with Standard Deviations, so 13 samples are taken at each observation and at different times. That the collected data represents a good shape of the population and it is not only a random variable, the collection plan was to measure every 5th customer only but 13 samples were taken. So we have not only a chance measure. This represent a cluster study plan.

VALUE STREAM MAP

For a better understanding of the three processes "Single Ticket", "Group Ticket" and "Season Ticket" a value stream map was designed. A value stream map show us the single steps in a process, how long one step goes and also the non-value added time as delays. The three processes was measured as an additional 10 times each, at different times and dates, to become a good average time for every process.

ANALYSE PHASE

ORDERED HISTOGRAM

A histogram itself is a diagram organized by groups. Each group is represented by a column. The height of the column depends on the sum of the events counted per group. The higher the column, the more events were counted in this group. The smaller the column, the fewer events were counted. If the columns were sorted from highest to lowest, an ordered histogram is created. The highest column represent the highest impact to a problem. If we solve the problem with the greatest influence on a process first, we have achieved the greatest improvement effect right at the beginning. In the project an ordered histogram from the "length of the queue" by time and location, "cash system problems" by location and from the "average fixing time" from a problem compared by location was made. The length of the queue by time and location show us that the customer frequency between 9 to 11 AM is less (<1m), 11 AM to 1 PM it is normal (1-2m), between 1 and 2.30 PM it is much (2-4m), 2.30 to 4.30 PM it is very much (>4m). So it is increasing continuously as later the time of the day is. The highest frequency is in the afternoon. But related to the ordered histogram the highest is Less frequency, the second is Much frequency, the third Normal frequency and the last is Very much frequency.

The results of ordered histograms about cash system problems shows that at first place we have revolving door system, at second digital cash system has no connection and on third cash system itself has no connection. Only Bachgraben location has at first place the digital cash system has no connection, because this location has no revolving door system yet. To fix a cash system problem it goes longest at St. Jakob location, with average of almost 100 hours to fix a problem, Bachgraben at second place and Eglisee location at third place. The causes for this long fixing times are unstable and not explaining disconnections of cash system equipment who runs again from alone sometimes and in other hands that the service company needs several days for an appointment at place.

PARETO CHART

An additional development of an ordered histogram with a more meaningfulness is a Pareto chart. It combines the ordered histogram with the cumulative percent of each pillars from the histogram. It is possible to read from the chart what percentage of a problem is solved if you fix which cause. As an example the data for the Pareto chart St. Jakob location with cash system problems is published below. In the column "St.Jakob" the counts for each category is summarized and ordered from highest to lowest. The sum of all counts is calculated in the total cell. As next the percentage from each category will calculated and the result will be in the % column. At least with the grid the cumulative sum will calculated and saved in the column "CUM %". This means as example, the "Revolving door system" has an impact of 35.71% in the % column. The "digital cash system no connection" has an impact of 23.81% in the % column. But now we add the % of "Revolving door system" 35.71% and "Digital cash system no connection" 23.81% and the result will give 59.52% which is displayed in the CUM % column. The rest of the categories is working and calculating in the same way. The Pareto chart itself is designed from the grid data and is published below. Now we can read from the chart that if we solve the three problems "Revolving door system", "Digital Cash System no connection" and "Cash system no connection" we solved 80% of our problems by cash system problems.

	St. Jakob	%	CUM. %
Revolving door system	4	35.71	35.71
Digital cash system no connection	3	23.81	59.52
Cash system no connection	2	21.43	80.95
To less changing money	1	9.52	90.48
Less printer paper	1	9.52	100.00
Printer not work	0	0.00	100.00
Total:	11	100.00	

Table 2 Grid for the Pareto chart

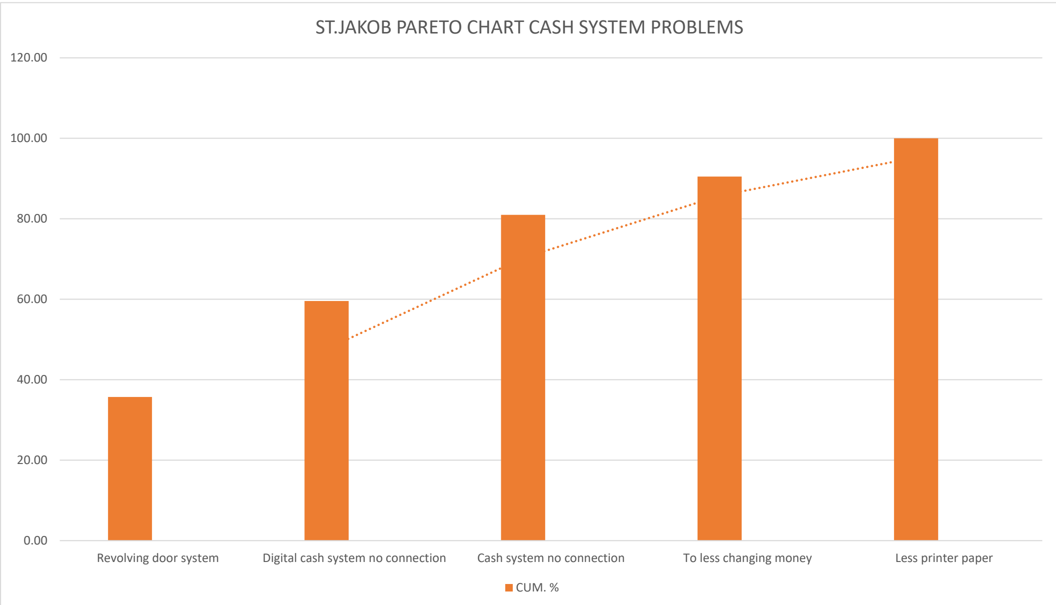

Table 3 St. Jakob Pareto Chart Cash System Problems

SEVEN WASTES

In Lean management the main approach is to avoid wastes for a smoothly process flow and commonly known are seven wastes: 1. Transportation and Logistics, 2. Inventory, 3. Motion, 4. Waiting, 5. Over processing, 6. Over production, 7. Defects. Within the measure and analyse phase it was found the wastes "waiting", "defects" and "over production" must be avoided. The waste "waiting" is related to the customer queue because the ticket process was to slowly at all in one hand, the season ticket process was too over-engineered and some days were not enough cash registers to handle all the customers in an acceptable time. The Season ticket process was to "over engineered" because taking a customer picture and some other data were not really necessary and last the "defects" were found in a lot of defects of not reliable point of sale equipment.

TACT TIME

The tact time tells us how many time we need to processing a service or product within a process step or for a full process, or how many time we can spend per service or product in maximum to process all items in a limited time.

The Point of sale system in St.Jakob location in high season are opened from averagely 9 AM until 7 PM, which is 10 hours or 600 minutes. In this time all customers must be processed. Customer with a prepaid ticket can use the automatic revolving door system. But when the cash system not works reliable with a lot of disconnections and the revolving door too, a long waiting queue occurs. Especially when there is not enough cash registers opened too. The tact time per customers is less as more customers enter the cash registers and can't use the automatic revolving door. As example with 2800 customers a day we have 600 minutes/2800 customers a day = 0.21 min each customer. If 60% can use the automatic revolving door we must only process 1120, which means 600 minutes/1120 customers = 0.53 minutes each customer. When we open two cash register the tact time is 1200 minutes which is the double. 1200 minutes/1120 customers = 1.07 minutes each customer. We can reach our project target to reduce the tact time at the point of sale to 1 to 2 minutes only, if we have a lot of prepaid tickets which can use the automatic revolving door and we have opened more than one cash register in high season at the mentioned days.

IMPROVE PHASE

BRAIN STORMING AND FMEA ANALYSIS

A Brainstorming is a creative tool where project members can say terms to a topic, what they have in their mind, but without a rating trough the members. After the finished session the terms would be collected in groups and in a discussion the sense for each term is made. In this project the terms were rated with an FMEA analysis, where F: Failure, M:Mode, E:Effects and A:Analysis are. So we are able to measure the risk for each term. The FMEA analysis rate the topics with Severity, Occurrence and Detection for each and with points between 1 to 10, where 1 is low and 10 is high. Then the points from Severity, Occurrence and Detection in each line are multiplied and as a result we get a Risk Priority Number. As higher the number, as higher the Risk for a topic.

The following ideas have a high RPN from the FMEA analysis, so it should be avoided in the new process:

1. Season tickets must be buy only online via online shop
2. The season ticket is not be replaced when it is lost
3. Schools must buy a group ticket online early before visiting

TARGET PROCESS AND TACT TIME REDUCTION

The aim of this project is to reduce the tact time to 1 to 2 minutes per service at the point of sale. After the measure and analysis phase, the following measures were decided to achieve this goal:

1. A shorter Season ticket process without photo and only with first name, second name and birthday will be launched.
2. A web shop where tickets can bought online will be launched
3. A programmer should debugging the source code of cash systems, card terminals and revolving door systems
4. A broadband internet connection will hosted
5. During high season which is from June to August, at Wednesday, Saturday and Sunday afternoon from 1 PM to 04:30 PM, two point of sale system are opened.
6. A website for all public swimming pools in Basle city are created and all locations update their information about occasions, opening hours, prices etc. regularly.
7. In the front of all point of sale systems a screen in the direction view of waiting queue is installed, with the information about occasions, opening hours, prices etc.

With this activities it should be minimizing customer questions at the point of sale and the processing time should be quicker.

CONTROL PHASE

HYPOTHESIS TESTING

A hypothesis test shows us whether the process has actually been improved or is just a random number. So that we know whether the process has actually improved, the tact time at the point of sale was measured again after the implementation of the new measures and process improvements. 12 measurements were carried out for the processes "Single Ticket", "Group Ticket" and "Season Ticket".

H0 Hypothesis: The new tact time from ticket process is not less than the old one.

H1 Hypothesis: The new tact time from ticket process is less than the old one.

Test:	Two sample t test
p value:	0.05

SINGLE TICKET	
BEFORE	AFTER
150	95
180	80
140	97
160	97
180	82
170	87
130	92
160	88
190	90
160	96
130	94
150	87

STABW.S:	6
AVERAGE:	90
p value:	< 0.00001

GROUP TICKET	
BEFORE	AFTER
210	102
225	100
235	99
180	100
250	105
220	96
250	92
260	97
240	99
220	100
220	102
280	98

STABW.S:	3
AVERAGE:	99
p value:	< 0.00001

SEASON TICKET	
BEFORE	AFTER
580	112
520	105
480	110
550	115
470	108
450	112
599	110
450	114
460	113
610	114
450	116
420	110

STABW.S:	3
AVERAGE:	112
p value:	< 0.00001

Table 4 Presamples and calculated p value for hypothesis testing

With a p value of 0.05 all calculated p values during the two sample t test are below, so we can reject the H0 hypothesis in favour of H1 hypothesis and we can conclude that the new process is better than the old one.

CONTROL CHARTS

With control charts it is possible to observe and control measurable processes. Dependent on the sample size there are exist different charts in Lean Six Sigma. In the project it was decided for a sample size of 13, which is related to Six Sigma as an intermediate sample size. With this sample size we can work with standard deviations, so our statements get more accuracy. Below is a table from Season ticket process with measured preliminary samples which is the basic to develop the charts.

	PRESAMPLES SEASON TICKET PROCESS				
	sec.	sec.	sec.	sec.	sec.
	102	98	105	102	97
	100	106	102	105	105
	99	107	108	102	104
	100	90	92	97	109
	105	95	97	98	105
	96	97	99	104	102
	92	103	103	106	115
	97	105	104	106	95
	99	101	106	104	99
	100	98	110	101	101
	102	98	111	99	102
	98	102	106	105	105
	105	102	108	107	110
MEAN	100	100	104	103	104
STABW.S	4	5	5	3	5
GRAND MEAN	102				
MEAN STABW.S	4				

Table 5 Presamples Season Ticket Process

The GRAND MEAN is built as Mean from Sample Means which is the centreline in X charts and the MEAN STAB.S as Mean from Sample STABW.S which is the centreline in the S charts. The X Chart show us if the sample means are shifted during the process. The S Chart show us if the sample standard deviations are shifted. Both charts have an UCL and LCL, the X chart has additional an USL and LSL. But in this project a LCL in both charts and LSL in the X chart is not necessary, because as lower the means and Standard Deviations as better for the customers and there isn't a limit. The USL was build related to a short customer survey, where customers said there are accept a maximum processing time of 2 minutes (120 seconds) for a ticketing process. An Example of X Bar chart and S chart can be found under ATTACHEMENTS. This charts were built for all three ticketing processes "Single Ticket", "Group Ticket" and "Season Ticket". The limits were calculated after common known shortcut formulas in Lean Six Sigma.

PROCESS CAPABILITY

$Cp = (USL - LSL)/ 6 * \sigma$ which is $(120 - 0) / 6 * 4 = \underline{5}$. So because the Cp value is >1 the process should be able to meet customer specification limits.

DISTRIBUTION OF SAMPLE MEANS

It is important to begin the topic of process design by drawing a clear distinction between a process mean and sample mean. A process mean represents the average level of output that a process is capable of delivering. A sample mean represents the average of a particular sample of items taken at the moment in time from this process. So it is simply one snapshot in time of the process average. However, and this is very important, a sample mean taken today will very differ from a sample mean taken tomorrow. With the UCL and LCL in the control charts we take this variation into account, so that the levels are as best positioned as possible to get all the variations within the levels. If a process and samples are normally distributed we can influence how much percent of the variations we cover within the levels. 1σ: 68% of variation is covered, 2σ: 95%, 3σ: 99.7% and with 6σ: 99.9997% of all variations are covered.

LEADERSHIP ISSUES AND NEGOTIATING

The project was a continuously change process and during the first time the people resist change, find reasons why the project anyway does not work and that they did a lot before, without any satisfied improvements, because the top management doesn't care anyway and not respect their work. So it need a lot of positive influence to lead the people step by step during the project, to motivate them and explain where and why there is many advantage. It also took a lot of self-confidence to stay motivated, despite the negative attitudes at first. Very helpful was the broad knowledge and experience with a calm stay during difficult situations. The management style was based on team management, but sometimes it took a while for the Authority Compliance Management style to do so. The negotiating style was a mix of give and take, if a team member resist to do their work. Helpfully was the give of a short celebration party after every step and a thick coat with humour. The negotiating style always were interested-based with sitting together after work in a loose round and the most, listening to the people.

RESULT AND CONCLUSIONS

The target of this project was to reduce the tact time at point of sale to 1 to 2 minutes and in this case also reduction the length of customer waiting line. Bot is reached with the new processes. A lot of wasted time was because not reliable point of sale equipment who which created traffic in the form of a long customer queue, not enough insufficiently operated cash registers, that the customers need too much information during the ticketing process because they not get the information before and that the season ticket buying process was too long because unnecessary steps.

LESSONS LEARNED

Change Management is the most important thing in all improvement processes and must be the base of everything that people are willing to give up their resists. Within the DMAIC steps the Define phase needs the most time, but it is an important step. A good business case and define what should be improved is very important to hold the line within the project. The project must be clearly defined so that you don't get lost. It is better to do several smaller sub-projects than one big one, but continuously.

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ATTACHMENTS

X CONTROL CHART SEASON TICKET

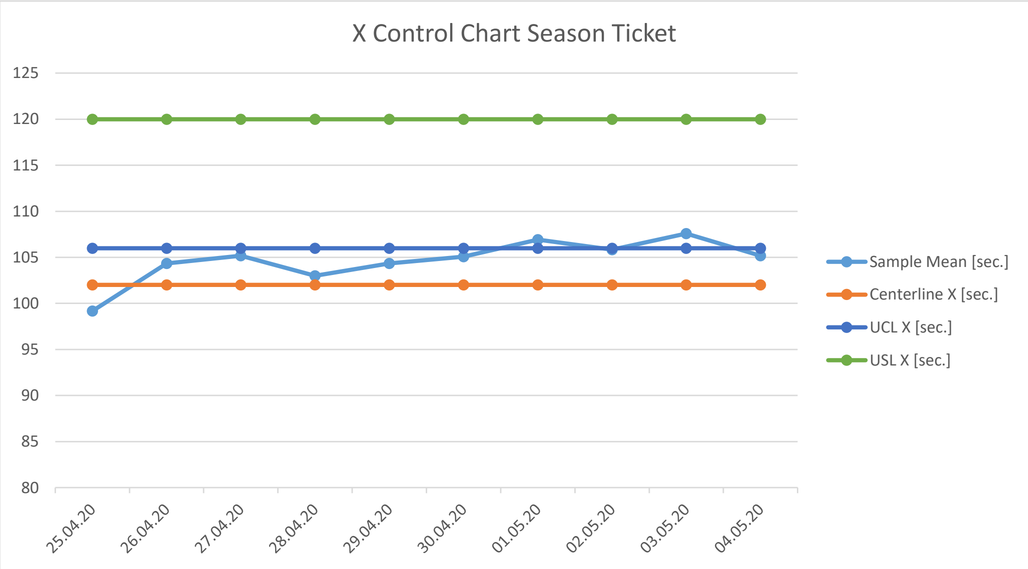

Table 6 X Control Chart Season Ticket

S CONTROL CHART SEASON TICKET

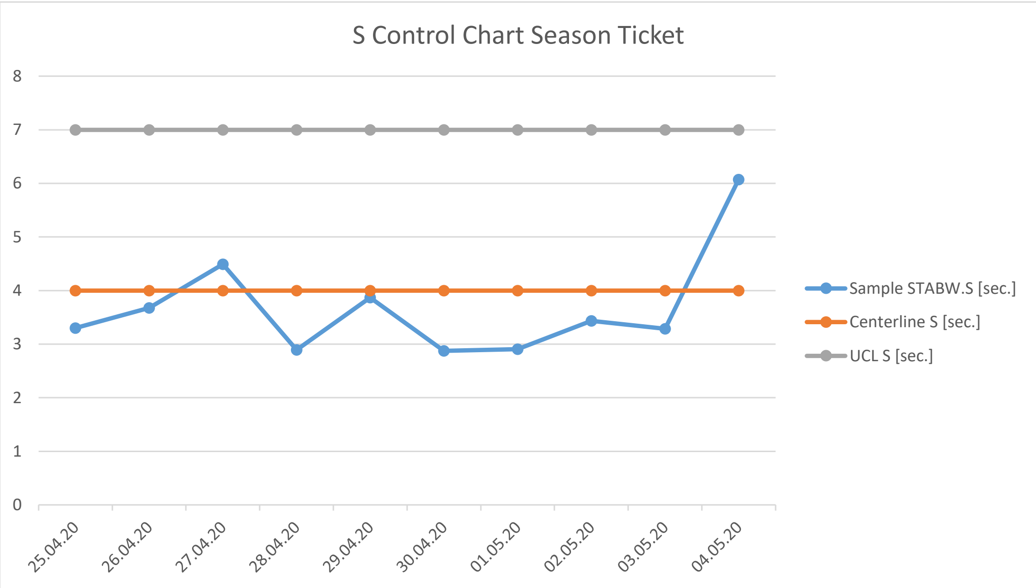

Table 7 S Control Chart Season Ticket

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SAMPLING DATA X AND S CONTROL CHART SEASON TICKET

Date:	Sample [sec.]	Date:	Sample [sec.]	Date:	Sample [sec.]	Date:	Sample [sec.]	Date:	Sample [sec.]
25.04.20	102	26.04.20	105	27.04.20	106	28.04.20	98	29.04.20	106
25.04.20	100	26.04.20	103	27.04.20	108	28.04.20	102	29.04.20	107
25.04.20	99	26.04.20	108	27.04.20	109	28.04.20	99	29.04.20	108
25.04.20	100	26.04.20	104	27.04.20	111	28.04.20	101	29.04.20	109
25.04.20	105	26.04.20	106	27.04.20	99	28.04.20	103	29.04.20	110
25.04.20	96	26.04.20	109	27.04.20	98	28.04.20	105	29.04.20	102
25.04.20	92	26.04.20	110	27.04.20	112	28.04.20	101	29.04.20	101
25.04.20	97	26.04.20	99	27.04.20	105	28.04.20	103	29.04.20	98
25.04.20	99	26.04.20	98	27.04.20	102	28.04.20	106	29.04.20	99
25.04.20	100	26.04.20	102	27.04.20	101	28.04.20	107	29.04.20	103
25.04.20	102	26.04.20	103	27.04.20	105	28.04.20	106	29.04.20	104
25.04.20	98	26.04.20	105	27.04.20	106	28.04.20	105	29.04.20	105
Sample Mean:	99	Sample Mean:	104	Sample Mean:	105	Sample Mean:	103	Sample Mean:	104
STABW.S:	3	STABW.S:	4	STABW.S:	4	STABW.S:	3	STABW.S:	4
Date:	Sample [sec.]	Date:	Sample [sec.]	Date:	Sample [sec.]	Date:	Sample [sec.]	Date:	Sample [sec.]
30.04.20	105	01.05.20	108	02.05.20	106	03.05.20	102	04.05.20	112
30.04.20	108	01.05.20	109	02.05.20	107	03.05.20	105	04.05.20	115
30.04.20	109	01.05.20	111	02.05.20	110	03.05.20	108	04.05.20	116
30.04.20	110	01.05.20	102	02.05.20	111	03.05.20	109	04.05.20	105
30.04.20	106	01.05.20	103	02.05.20	105	03.05.20	110	04.05.20	102
30.04.20	102	01.05.20	104	02.05.20	102	03.05.20	102	04.05.20	101
30.04.20	103	01.05.20	106	02.05.20	101	03.05.20	106	04.05.20	99
30.04.20	101	01.05.20	107	02.05.20	103	03.05.20	107	04.05.20	98
30.04.20	104	01.05.20	109	02.05.20	105	03.05.20	111	04.05.20	105
30.04.20	106	01.05.20	110	02.05.20	108	03.05.20	112	04.05.20	102
30.04.20	105	01.05.20	109	02.05.20	110	03.05.20	109	04.05.20	101
30.04.20	102	01.05.20	105	02.05.20	102	03.05.20	110	04.05.20	106
Sample Mean:	105	Sample Mean:	107	Sample Mean:	106	Sample Mean:	108	Sample Mean:	105
STABW.S:	3	STABW.S:	3	STABW.S:	3	STABW.S:	3	STABW.S:	6

Table 8 Sampling Data X and S control charts Season Ticket

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VALUE STREAM MAP SEASON TICKET BEFORE IMPROVEMENT

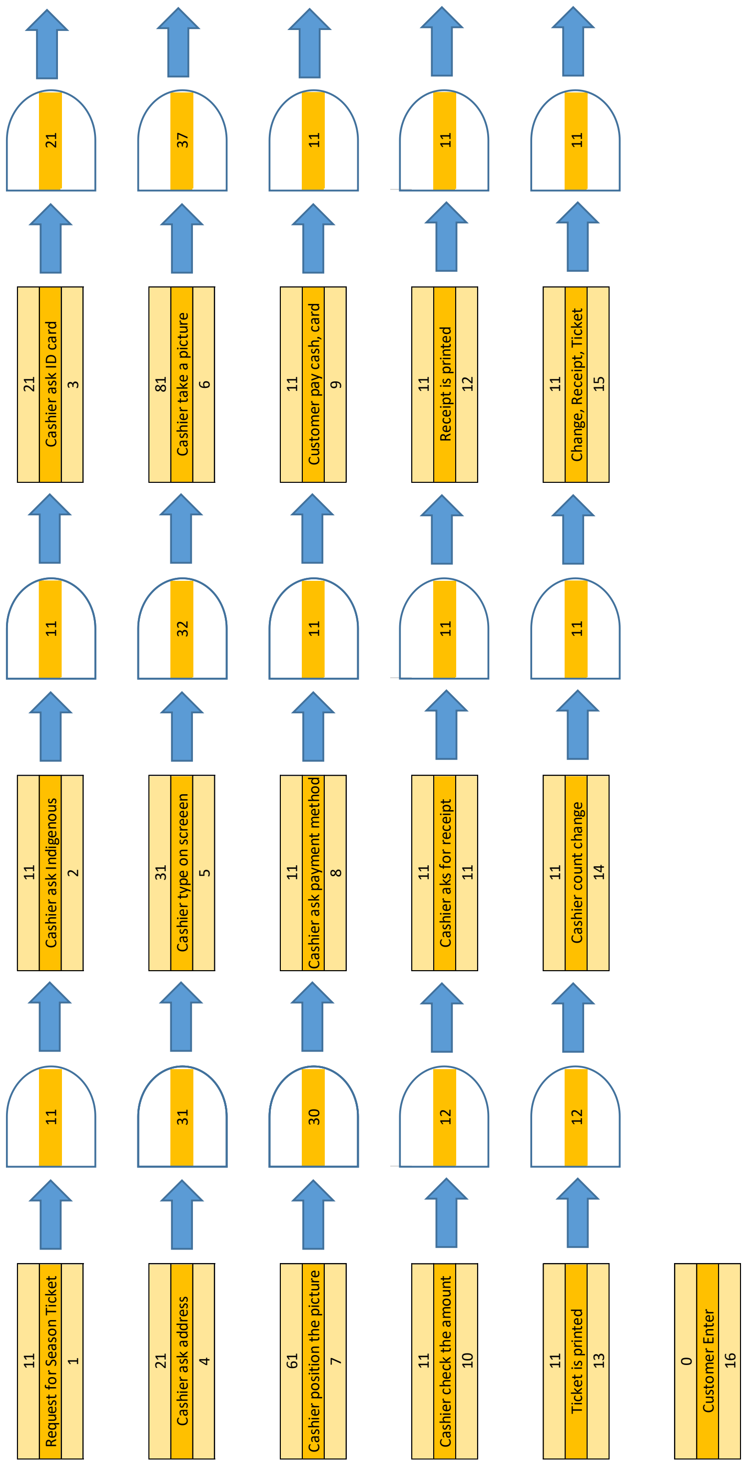

Table 9 Value Stream Map Season Ticket before improvement

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EXAMPLE OF A MEASUREMENT REGISTRATION FORM

ALLOCATIONS					TAKT TIME	ENTRANCE CATEGORY			CUSTOMER FREQUENTATION				CASH SYSTEM PROBLEMS						CASH SYSTEM PROBLEM IS FIXED		
LOCATION:	SAMPLE GROUP NUMBER:	MEASURE NUMBER:	DATE:	START TIME SAMPLE GROUP:	TAKT TIME [SEC.] MESURE EACH STH:	SINGLE TICKET (mark it with an x):	GROUP TICKET (mark it with an x):	SEASON TICKET (mark it with an x):	LESS queue is <= 1m long (mark it with an x):	NORMAL queue is 1-2m long (mark it with an x):	MUCH queue is 2-4m long (mark it with an x):	VERY MUCH queue is >4m long (mark it with an x):	Cash system has no connection to database (mark it with an x):	To less changing money (mark it with an x):	Digital Cash System doesn't work (mark it with an x):	Printer for receipts doesn't works (mark it with an x):	To less printer paper (mark it with an x):	Revolving door system doesn't work (mark it with an x):	Problem is fixed (mark it with an x):	How long run the problem until fixed? Fill in the time in minutes.	
St. Jakob	1	1	11.04.2020	9:00:00 AM	150	x			x									x	x	Minutes:	30
St. Jakob	1	2	11.04.2020	9:00:00 AM	180	x			x									x	x	Minutes:	40
St. Jakob	1	3	11.04.2020	9:00:00 AM	120	x			x											Minutes:	
St. Jakob	1	4	11.04.2020	9:00:00 AM	125	x			x											Minutes:	
St. Jakob	1	5	11.04.2020	9:00:00 AM	130	x			x											Minutes:	
St. Jakob	1	6	11.04.2020	9:00:00 AM	580			x	x											Minutes:	
St. Jakob	1	7	11.04.2020	9:00:00 AM	210		x		x											Minutes:	
St. Jakob	1	8	11.04.2020	9:00:00 AM	165	x			x											Minutes:	
St. Jakob	1	9	11.04.2020	9:00:00 AM	225	x	x		x											Minutes:	
St. Jakob	1	10	11.04.2020	9:00:00 AM	235		x		x											Minutes:	
St. Jakob	1	11	11.04.2020	9:00:00 AM	520			x	x											Minutes:	
St. Jakob	1	12	11.04.2020	9:00:00 AM	112	x			x											Minutes:	

Table 10 Example of a measurement registration form

MULTI VARI CHART AVERAGE PROCESSING TIME SINGLE TICKET

	AVERAGE PROCESSING TIME SINGLE TICKET		
	St. Jakob	Eglisee	Bachgraben
	1	2	3
	3.10	2.62	2.60
	2.88	3.16	2.33
	3.28	3.13	3.53
	3.16	2.31	2.75
Average:	3.11	2.81	2.80
Max:	3.28	3.16	3.53
Min:	2.88	2.31	2.33

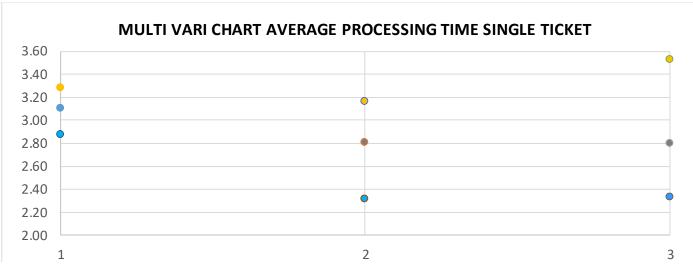

Table 11 Multi Vari Chart Average Processing Time Single Ticket

MULTI VARI CHART AVERAGE PROCESSING TIME GROUP TICKET

	AVERAGE PROCESSING TIME GROUP TICKET		
	St. Jakob	Eglisee	Bachgraben
	1	2	3
	3.67	4.46	5.02
	4.10	4.49	4.49
	3.84	3.44	3.36
	3.19	3.33	3.25
Average:	3.70	3.93	4.03
Max:	4.10	4.49	5.02
Min:	3.19	3.33	3.25

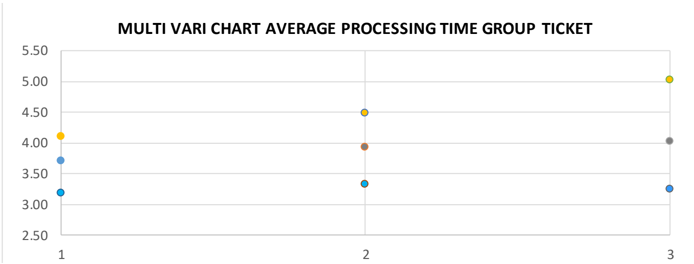

Table 12 Multi Vari Chart Average Processing Time Group Ticket

MULTI VARI CHART AVERAGE PROCESSING TIME SEASON TICKET

	AVERAGE PROCESSING TIME SEASON TICKET		
	St. Jakob	Eglisee	Bachgraben
	1	2	3
	8.62	6.79	8.38
	7.25	7.35	7.27
	7.89	7.18	7.19
	7.43	7.33	7.85
Average:	7.80	7.16	7.67
Max:	8.62	7.35	8.38
Min:	7.25	6.79	7.19

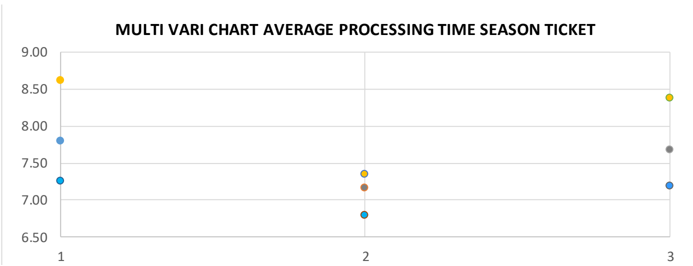

Table 13 Multi Vari Chart Average Processing Time Season Ticket

BIBLIOGRAPHY

comp. Canton of Basel city. (2019, April 24). *www.bs.ch*. Retrieved from https://www.bs.ch/nm/2019-saisonbeginn-in-den-basler-gartenbaedern-ed.html

comp. Canton of Basel city. (2020, April 09). *https://www.jfs.bs.ch/*. Retrieved from https://www.jfs.bs.ch/fuer-sportlerinnen-und-sportler/sportanlagen/gartenbaeder/gartenbad-st-jakob.html

comp. Schwald, A. (2019, July 10). *www.bzbasel.ch*. Retrieved from https://www.bzbasel.ch/basel/basel-stadt/trotz-gefahren-und-laermklagen-basler-bleiben-am-rhein-badi-eintritte-sinken-jahr-fuer-jahr-134732580

TABLES

LIST OF ABBREVIATIONS

LCL *Lower Control Limit*
LSL *Lower Specification Limit*
SFr. *Swiss Francs*
UCL *Upper Control Limit*
USL *Upper Specification Limit*