STATISTICAL ANALYSIS OF IT SERVICE DESK INCIDENTS WITH OBJECTIVE TARGET FOR OPTIMISATION OF SERVICE LEVEL AGREEMENTS

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Since year 2004 an in-sourced IT Service Desk of German Air Navigation Service is operated based on the Single Point of Contact (SPOC) to the customer of the German wide used Business Support Systems and ATM-shore Applications. The IT Service Desk operation is managed and controlled by Key Performance Indicators (KPI); because the insourcing project have been performed under the condition that the service is delivered at market conform conditions. Main parameters of SLA are based on arithmetic mean values. During review process of actual SLA parameter and customer pitches different lacks of calculation of service parameter have been detected.

For a better evaluation of service quality it was decided to change arithmetic mean values for service parameter, due to the fact that arithmetic means stretch and "dilute" the different contents of service parameter. Average values for performance information are not sufficient for the service management. With help of quantiles it will be possible to fulfil the defined limits for different parameter ranges, especially for time and performance related parameter for the IT-Service desk. So it will be a better way to define quantified and differentiated service statements based on specified quantile Q_p.

The goal of statistical analysis is to investigate the observed service parameters and different technical analyses of serviced applications to derive technical expertise for an implementation of statistical quantiles as a basis function for service parameters.

The results of statistical analysis of Service Desk Incidents is to be able to offer the mentioned KPIs by different requested quantiles for the SLA and to be able to offer these KPIs on higher scientific level. The results of statistical investigation will also be used for a more stabile forecasting and annual planning of service capacity and resources. The quantile distribution can be used for the incident distribution of service desk portfolio. So it can be decided that product releases shall switch into operation only by fulfilment of specified quantile Q_p. In the paper typical and market conform service parameters for an IT Service Desk have been researched and the results of statistical analysis will be applied for further restructuring at operational use and adaptation of SLA.

Keywords: *technical statistical analysis, categorization IT incidents, impact on SLA, service availability, service quantiles*

1. Problem Identification Using of Arithmetic Mean KPIs

For the service description of IT Service Desk normally the following different parameter will be used and categorized as it is shown on Figure1. This figure is a screen shot of data base by IT Service Process Modelling.

These parameters are normally measured as an average value by different measurement periods.
Parameters for capacity and resource planning:

- Average number of incoming Incidents by hours, days, month and year

$$where \sum_{i=1}^{2700} P(A_i) = 1, i_{\max\, numberincidentspermonth} = 2700 \quad (1)$$

is the maximum capacity for DFS IT Service Desk

- Average number per customer per year
- Number of Full Time Equivalents of IT Service Desk
- Number of solved incidents per Service Desk Supporter
- Number of supported customers and applications

Service Quality Parameters:

- Average of Incident Time Acceptance

$$R_{DirectContact} = \frac{N_{handledIncidentsperMonth}}{\sum_{n=1}^{2700} N_{handled} + N_{Aborted} + N_{\mathrm{Re}cordedI}} * 100\% = 95\%; t \le 45\,\mathrm{sec} \quad (2)$$

- Average of direct accept incidents
- Average of Incidents by waiting / aborting
- Direct incident solution rate by given time slots

$$R_{DirectSolution} = \frac{N_{SolvedIncidentsperMonth}}{\sum_{n=1}^{2700} N_{handledIncidents} + N_{\mathrm{Re}cordedIncidents}} * 100\% = 80\%; \quad (3)$$

$$t_{Solution} \le 15\,\mathrm{min}; P(A) = 0{,}80 \quad (4)$$

$$t_{Solution} \le 60\,\mathrm{min}; P(A) = 0{,}15$$

$$t_{Solution} \le 24 hours; P(A) = 0{,}05$$

- Statistical distribution of incidents per specific application

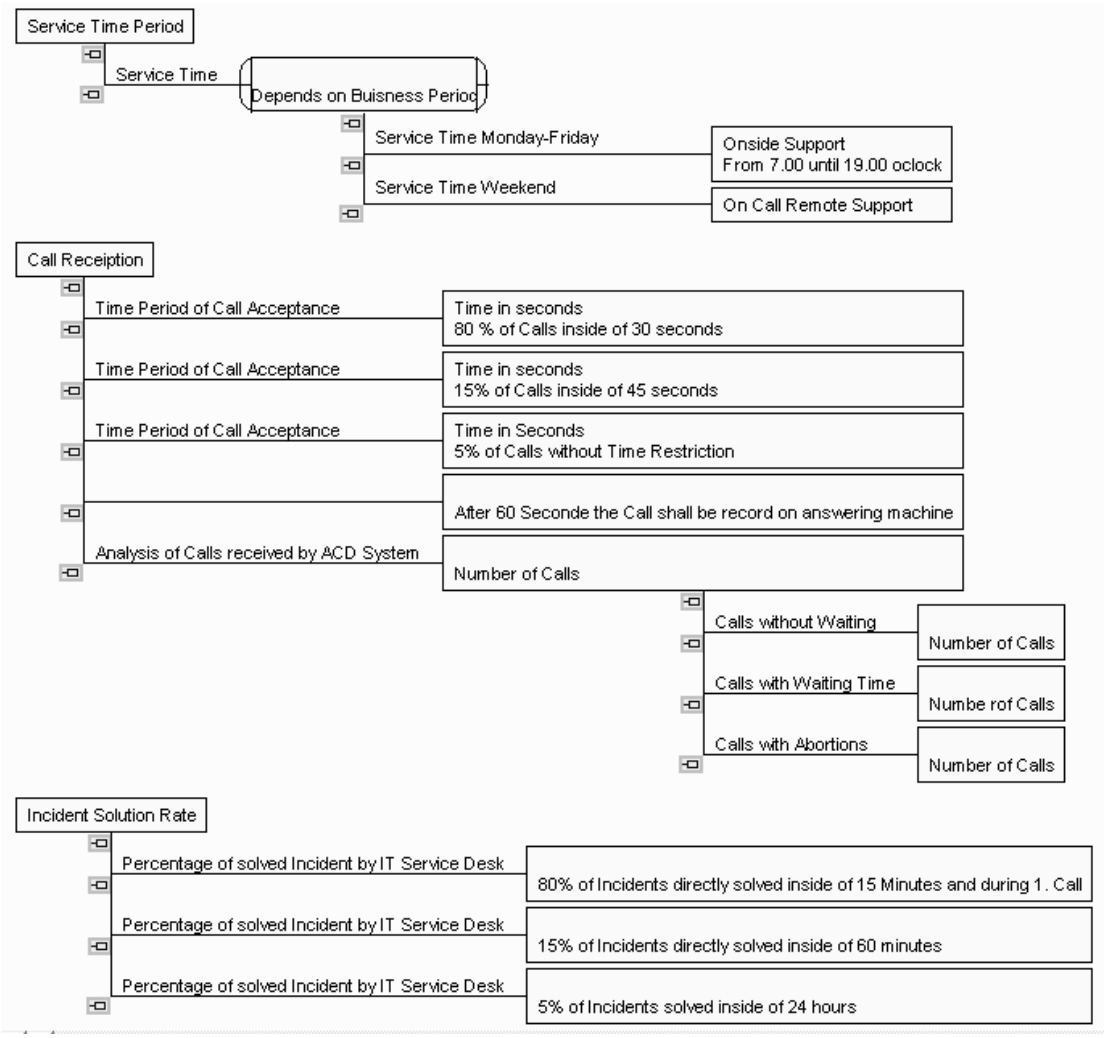


Figure 1. Subset of typically IT Service Desk Parameter

Process related Parameters:
- Average time period of Incident solution by 1st / 2nd / 3rd Level Support
- Mean number of escalated incidents to the different service level and management intention

Economical Parameters:
- General cost of Service Module "IT Service Desk"
- Cost per Incident / Customer / Application

Since starting of operational use of in-sourced IT Service Desk these different parameters were collected and analysed by the monthly management reporting. This information data base was used for the short and medium term planning activities of the resource, capacity and product planning. Based on the experiences of

these planning activities and regularly performed customer pitches it was detected that the measured average parameters contained a lot of disadvantages, because average parameters diluted the real content of parameters. Especially for detailed demand planning of resource this dilution effect has a strong negative effect to the quality. Also the customer is not willing to accept average service level parameter. The ATC business units require the delivery of complete end-to-end service lines lately. The "dilution" effect of service parameter by arithmetic averages will be exponentiated by design and modelling of service lines because arithmetic mean values are used always as input parameters for the service line calculation. So this exponentiated effect by service lines has a negative impact on the controlling and differentiation of required service qualities.

The usage of parameters with different ranges is observed as an additional negative effect. So the dilution effect of parameters in addition also depends on the used time ranges and performing of evolutionary measurement series, like hourly-daily-monthly measurement profiles. Another problem of synchronization by usage of average service parameters is observed, it means the correlation and principle of cause and effect during the SLA controlling and the service performance cannot be ensured by usage of mean values. It is necessary that the parameter measurements are performed synchronously by time and event-oriented parameter. The synchronously measurement cannot be ensured by usage of average service parameters.

The ATC services have effected on national level, for example, for the modelling of Radar Surveillance Data Processing and can reach up to European level for the modelling of ATM-Management and Flight Data Processing.

In addition for ATC purposes it shall be differentiated between different categories of services which also depend on different locations and business processes. For example, the requirements to the services can be different between small Regional, European Access and International HUB ATC-Tower location, because the business need is different too.

Normally the service level agreements contain yearly average service parameters for the specific service module, like mean availability per year, mean solution rates, mean reaction time period. So it has been detected that based on mean parameter a selective controlling and management of service is not possible. In addition the customer service requirements have changed lately. The customer requires now a more specific and sophisticated service level, which is more differentiated of service quality and more selective service over the supported service period. This new quality and sophistication of service level requires a detailed statistical analysis by different views and the need of differentiation and flexibility of delivered service quality by different time period over the normal business day. After all it must be noted that the up to now the used average SLA- parameters are no more useful for the service management of business and customer requirements. Especially for delivery of standardized IT services on centralized IT infrastructure the offered specific application related services should be modelled more target-oriented and business-oriented. With respect to this experience it is decided to perform a statistical analysis of the Service Desk information data base.

2. Results of Statistical Analysis of IT-Service Desk Parameters

The statistical input data base contains the following kinds of input data:

- Statistical Amount of Incidents sorted by different service quality since beginning of operational use of IT Service Desk based on an in-sourcing project on monthly time period.
- Technical analysis of Incidents qualified by the mainly used applications.
- Data collection of SLA-defined parameter for the IT-Service Desk reported by the central service management tool "Oblicore".

The statistical data has been collected since beginning of operation of DFS in-sourced IT Service in October 2004 and contains over 120.000 incoming incidents, which are collected by the Automated Call Distribution System (ACD). The result of the descriptive statistical parameter for Incident in 2007 is given in Table 1.

Table 1. Summary of main descriptive statistical parameters

	Descriptive Statistics (UHD Incident Distribution in StatisticUHDIncidentDistribution V01)										
Variable	Mean	Confidence -95,000%	Confidence +95,000%	Median	Sum	Minimum	Maximum	Lower Quartile	Upper Quartile	Std.Dev.	Standard Error
Operational Month	38899,79	38782,23	39017,35	38899,00	1672691	38261,00	39539,00	38565,00	39234,00	381,9947	58,2537
Receiving Incidents	2797,86	2594,98	3000,74	2743,00	120308	1826,00	4916,00	2208,00	3155,00	659,2196	100,5300
Receiving Incidents without Interruption	2569,30	2389,08	2749,53	2522,00	110480	1592,00	4558,00	2052,00	2856,00	585,6102	89,3047
Incidents without Waiting Time	2046,81	1933,35	2160,27	2033,00	88013	1244,00	3057,00	1809,00	2269,00	368,6729	56,2221
Incident with Waiting Time	273,12	233,02	313,21	264,00	11744	95,00	798,00	183,00	321,00	130,2792	19,8674
Incidents on Calling Maschine	250,35	208,35	292,35	250,00	10765	44,00	712,00	133,00	315,00	136,4602	20,8100
Real Incident inside Data Base	1958,88	1805,91	2111,85	1962,00	84232	724,00	3530,00	1619,00	2221,00	497,0550	75,8002
Percentage Incidents / Interruption	76,02	73,46	78,59	77,77	3269	45,48	95,95	74,48	79,69	8,3287	1,2701

Based on the descriptive parameters the distribution of incident types shall be evaluated by scatter plots. The goal of this scatter plot evaluation of incidents is to analyse and to approve that the incidents are distributed inside of the 95% confidence level. The Figure 2 approves that the most numbers of different incident will fulfill this given confidence level. This result is important because the 95% confidence level will be the basis for the further restructuring of service parameter by quantiles.

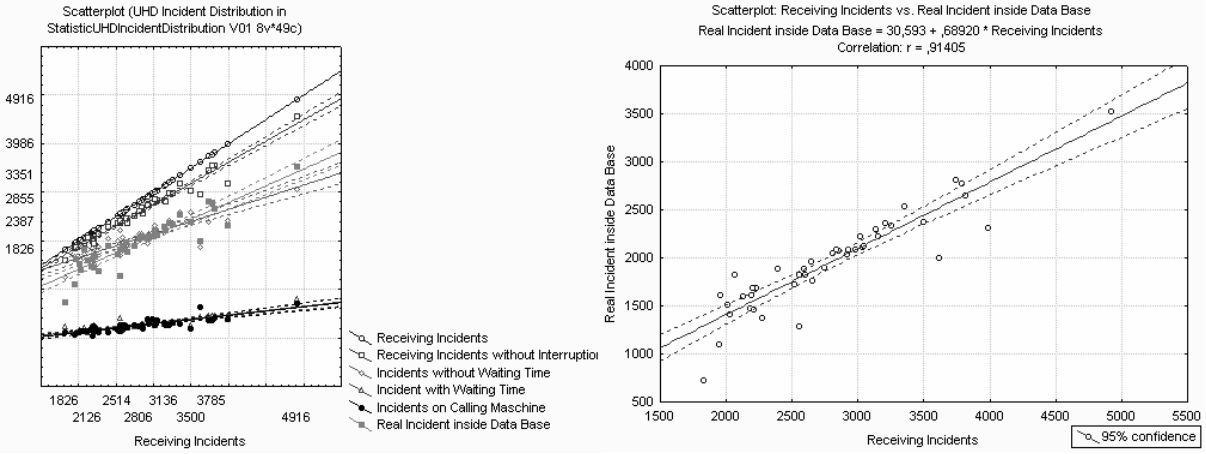


Figure 2. Scatter Plots of IT Service Desk Incident Distribution in 2007

Findings of the statistical analysis of IT Service Desk incident distribution:

- The distribution of IT Service Desk incidents is homogenously.
- The high values of standard deviation and standard error reflect that the incident types are not performed by a scientific statistical method like cluster analysis and is not calculated by different similarity or distance coefficients like Minowski distance or Euclidian distance.
- The clustering of different incident types is defined by practical reason and operational business need with respect to the customer requirements.
- Over the operational period around 36.000 incidents per year are expected. The following analysis by using of service management and controlling tool "Oblicore" approves that the incoming incidents are higher than the calculated capacity N = 2700 per month by of IT Service Desk.

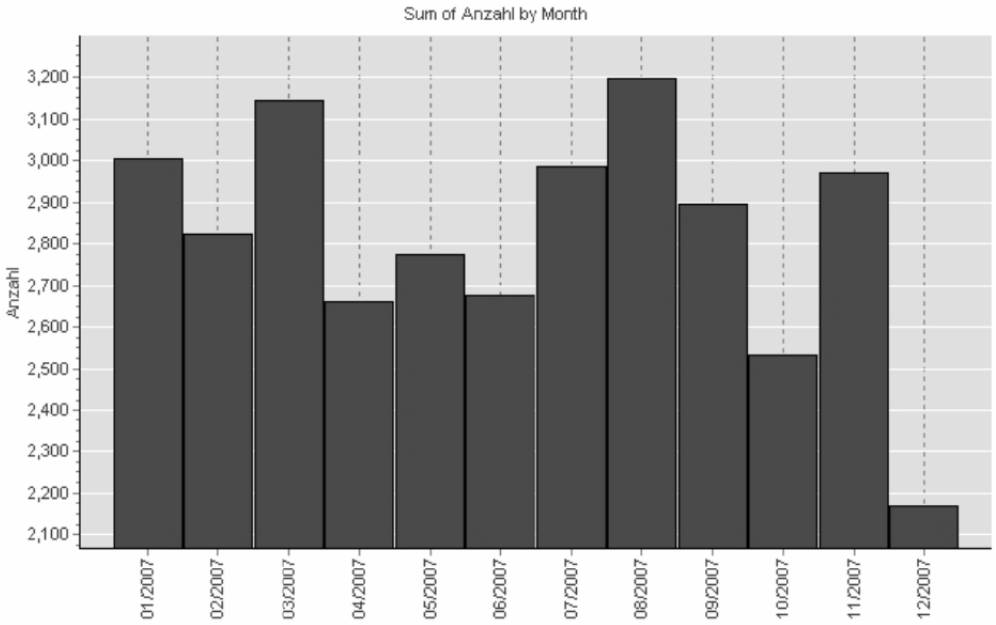


Figure 3. Distribution of incoming monthly Incidents in 2007

Based on these findings special issues to define actions to increase the capacity of IT Service Desk are established. The main goals are not to increase the personnel resource but to increase the automation level of incident processing.

- The Figure 4 shows the percentage of direct solved incidents by different categories by the IT Service Desk. This analysis approves that the IT Service Desk over fulfils the service requirements for direct solution. The fulfilment for this specific requirement is very important for the customer satisfaction. The availability of the service is higher than the required one. But over the operational time period it is not visible that the system will reach more robustness and stability.

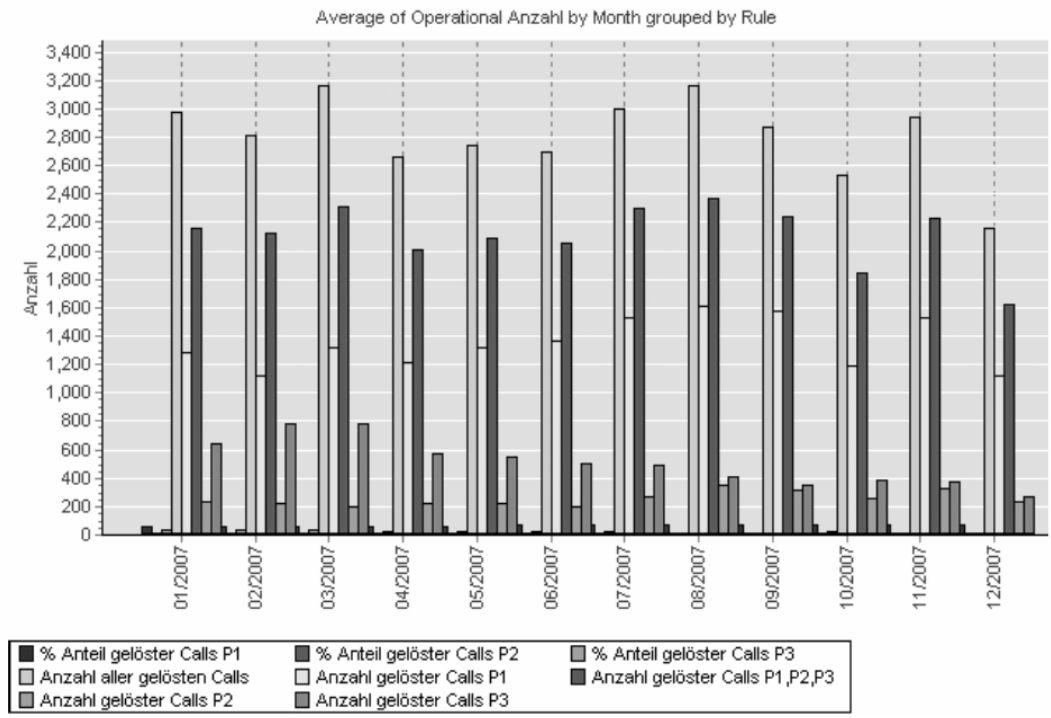


Figure 4. Percentage of direct solution sorted by different category of incidents

3. Implementation of Quantile based Service Parameters for an ATC related IT-Service Desk

An important result of statistical analysis and problem analysis is the need of SLA redesign. The goal of restructuring of SLA is to satisfy the business requirements in more detail, so we propose to use quantiles in place of arithmetic mean values for description of service parameters. Average values for performance information are not sufficient for the service management. With help of quantiles it will be possible to fulfil the defined limits for different parameter ranges, especially for time and performance related parameter for the IT-Service desk. So it will be a better way to define quantified and differentiated service statements based on specified quantile Q_p. We suggest changing the arithmetic mean parameters into detailed quantile values Q_p and statistical distribution p.

$$F^{-1}(p) := \inf\{\chi \in R : F(\chi) \geq p\}, \tag{5}$$

where χ – randomly variable, $x_1,...,x_n$ is an ordered series of measurements;

F – distribution function;

$\rho \in (0,1)$ – real numeral.

The p-quantile describes the inverse function to the related distribution.

For practical use of IT Service Desk parameter definition we can purpose the following proceeding.

- Definition of quantile for incoming incident distribution over the service time period. The number of incoming incidents over the IT Service Desk working day depends directly on customer behaviour and has impact on resource planning, direct solution rate and incident acceptance rate. For better capacity planning and for more economical usage of resources it makes sense to define specific quantile / quintile $Q_{.2}$ as minimum quality level. It means for $Q_{.2}$ 20% of incoming incidents can be violated the given performance parameter.

  $t_{acceptance\ time}$ >= 30 seconds

  $t_{direct\ solution}$ >= 15 minutes

These quantiles can be calculated over the complete service time per day or in more detail for the working peak periods (from 8.00 to 11.00 o'clock / 13.00 to 16.00 o'clock).

- In addition the distribution of incoming incidents can be used for quantile definition of demand calculation of needed service desk supporter (FTE Full Time Equivalents). The definition of quantile can be performed by the following views:
  - Correlation between the numbers of incoming incidents with available FTE.
  - Correlation between the numbers incoming incidents with performance parameters like acceptance time, direct solution rate or incident number with waiting time / abort.

  As an example the evaluation of real incoming incidents and solution rate is performed and presented by Box & Whisker Plots on Figure 5. It can be observed that the standard deviation range is relative small. This output approves the significance of statistical input data base and small range distributed incidents of IT Service Desk. The figure shows the Box & Whisker Plots for monthly distribution of incidents and direct solution rate of Incidents.

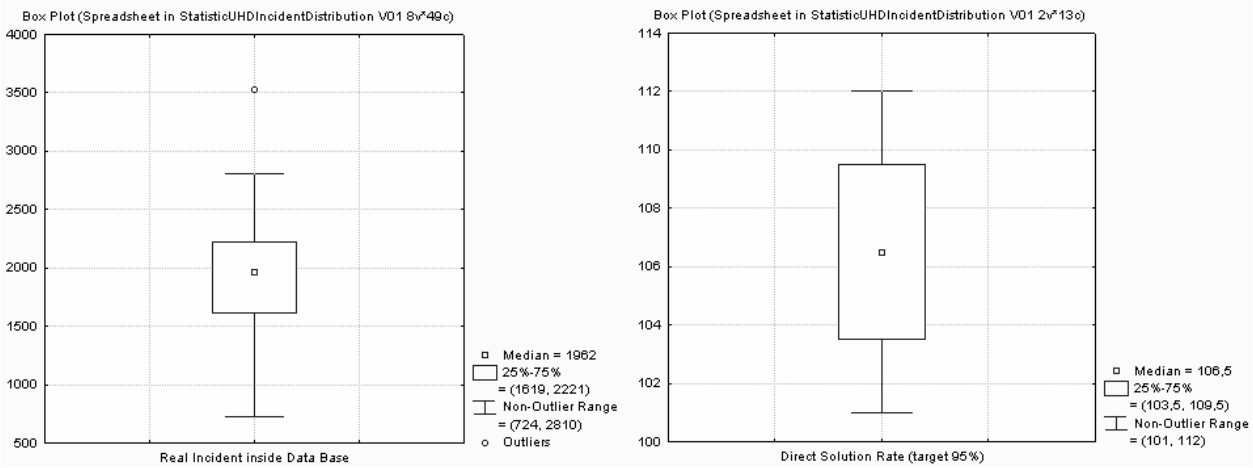
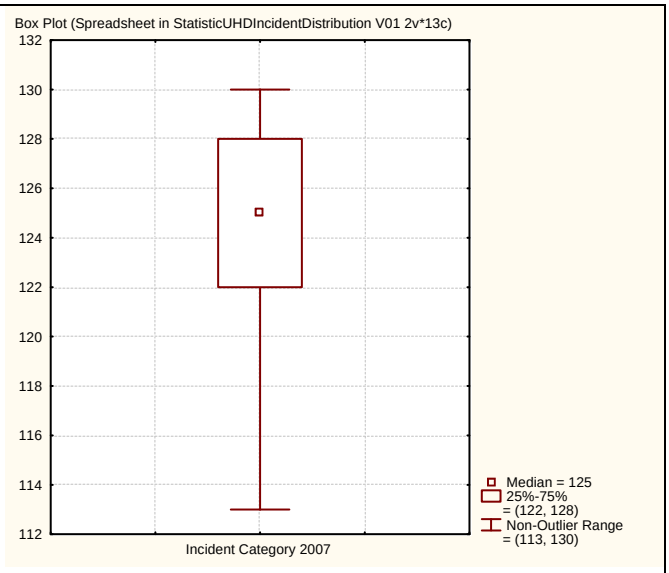


Figure 5. Box & Whisker Plots Incident Data Base and Direct Solution Rate

- Also for product management and planning purposes it will be suggested to perform quantile analysis. The quantile distribution can be used for the incident distribution about specific products or product releases. So the incident distribution of service desk portfolio can be statistically analysed by correlation of defined quantile $Q_{p.}$ So it can be decided that product releases shall switch into operation only by fulfilment of the specified quantile Q_p. Figure 6 gives an example of possible categorisation for product related quantiles via Box & Whisker Plots. A more detailed drill down into the different applications is possible.

	Incident Category 2007	Number Incidents
1	Service Desk Incident Sum	24587
2	Applications	13856
3	Client	4846
4	Data Storage	5
5	DHCP	4
6	Printer	203
7	Workflows	2
8	Network	2092
9	PDA Smartphones	427
10	Server	2972
11	User	120



	Incident Client	Number Incident
1	Client	4848
2	Working Place	959
3	Basis-Image	5
4	Operating System	389
5	CD-Brunner	41
6	Desktop	52
7	Printer	1634
8	Copy	11
9	Monitor	274
10	Scanner	212
11	Remote Working Place	14
12	USB-Devices	274
13	VPN	261
14	Network-Notebooks	722

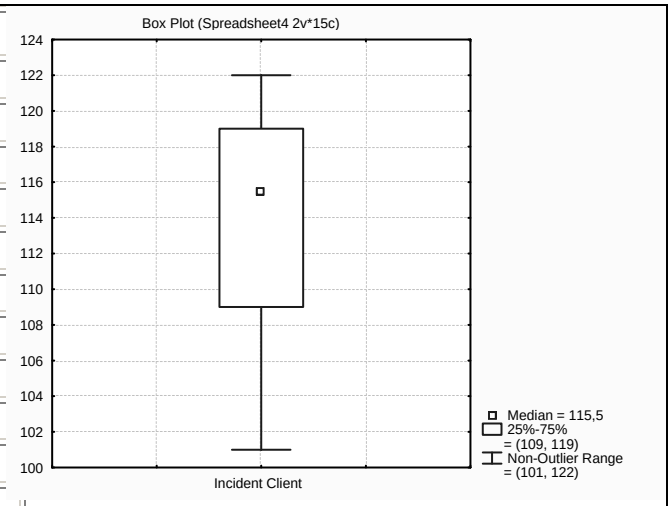


Figure 6. Distribution and quantile of incident distribution categories

Conclusions

The statistical analysis gives the scientific approval of the following findings and conclusions:

- Based on the actual statistical data base of IT Service Desk it is possible to perform analysis a generation of service parameters and capacity planning metrics.
- From investigation point of view the up to now used SLA parameter is not sufficient for a sophisticated description of service quality. It is necessary to restructure and redesign the SLA based on new parameters, which are defined on statistical quantiles. From the SLA point of view it should be agreed also to perform a product related statistical analysis.
- From statistical point of view it is visible that the number of incidents over operational years reached a stabile level now, which is over the normal capacity of IT Service Desk.

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