TL 9000 Measurement Outputs and Calculations

Revised 1 July 2005

All measurement calculations are to be performed using the formulas in the TL 9000 Measurements Handbook. This document provides supplemental information about how the Industry Trend data are calculated – including smoothing and data eligibility rules.

The TL 9000 industry trend data uses only the data from certified registrations. Data from registrations that are not certified are not used. In addition, the data must meet the requirements of Section 3.5.2.d of the Measurements Handbook, which states the data for any output data point must be derived from data submitted by three or more companies.

All calculated outputs are reported by the month. When data are combined from multiple submissions they are converted, if necessary, to monthly data. For example, if data are submitted for a 4-week fiscal month they are converted to a calendar month before being used in the output formulas.

Certified Registration

A certified registration is a TL 9000 registration that has been certified compliant to TL 9000 by a recognized registrar/certification body. That is, a certified registration is one that has passed its audit.

Outputs

There are four TL 9000 industry trend data outputs derived from the submitted TL 9000 data per product category and per measurement

- Best in Class
- Worst in Class
- Industry Average
- Monthly Average

Best in Class, Worst in Class, and Industry Average calculations for a particular month are based on data submitted from several previous months, which is called a time window. The time window is either 6 or 12 months depending on the measurement as defined in Table 5.

Best in Class is the best performance from a single registration for a product category for a particular measurement. For some measurements, the optimum performance is zero while for others it is 100, as shown in Table 5. Worst in Class is the worst performance from a single certified registration. Industry Average is the composite average of data from all eligible submissions over a defined time window.

Smoothed Outputs

Best in Class, Worst in Class, and Industry Average performance data calculations are derived from data over a period of multiple consecutive months, which is referred to as 'smoothing'. For some measurements, a 6-month time window is used and in other cases a 12-month time window is used, as shown in Table 5. In all cases, reporting of smoothed data starts after 6 months of data are available. For those measurements with a 12-month time window, the benchmarking expands to include additional data (up to 12 months) as the data becomes available. After

obtaining 12 months of information, then the most immediate 12 months are used for further calculations. See Example A for more detail.

Best In Class

The Best-in-Class data point, in a particular month, is the best performance for a single certified registration for that measurement over the appropriate time window shown in Table 5, from all eligible data submitted.

Worst In Class

The Worst-in-Class data point, in a particular month, is the worst performance for a single certified registration for that measurement over the appropriate time window shown in Table 5, from all eligible data submitted.

Industry Average

The Industry Average data point, in a particular month, is the composite average data for that measurement over the time window, shown in Table 5, from all eligible data submitted.

Monthly Average

The Monthly Average data point, in a particular month, is the composite average data for that measurement for that month only. The only eligibility rule that applies to the monthly average is that the data comes from certified registrations from three or more companies.

Composite Average

The composite average applies only to data from multiple submissions. Each output measurement is defined in the TL 9000 Measurements Handbook as a formula applied to one or more input data points. The composite average is derived by applying the formula to the summed values of the individual inputs of the data submissions. That is, all the values for the same measurement are summed from the data submissions and then the summed values are used in the formula. Scaling factors such as annualization or percentage are not summed.

Composite Average Example for a Single Month

The TL 9000 outputs, such as NPR1, are derived from certified registration data submitted to the Measurements Repository System. These data are combined to produce the average by adding the individual numerators and denominators, and then applying the appropriate formula from the Measurements Handbook to the summed inputs. For example, the formula for NPR1 is

NPR1 = Afactor*Np1/NPRs

Assume there are 5 data submissions from certified registrations during a single month for NPR as follows:

Submission	1	2	3	4	5
Np1	2	5	4	2	3
NPRs	15	30	20	16	30
Afactor	12	12	12	12	12

The calculated output, NPR1, for each submission is

Submission	1	2	3	4	5
NPR1	1.6	2.0	2.4	1.5	1.2

The total of numerators, Np1, is 2+5+4+2+3 = 16 and the total of denominators, NPRs, is 15+30+20+16+30 = 111. The annualization factor, 12, is a scaling factor and thus is not summed. The Monthly Average is therefore 12*16/111 = 1.73.

The Industry Average is calculated in a similar way. It simply includes all eligible data submitted over the defined time window. Note that eligibility rules are applied to all smoothed calculations.

Eligibility Rules

Only data from certified registrations are eligible for inclusion in these calculations.

Data from a certified registration are eligible for the Best in Class designation in a particular month when the data from the registration meet either of the following two conditions: 1) The data represent 2% or more of the sum of the denominators for that measurement over the time window. 2) For certain measurements and product categories, the data are greater than a non-zero threshold as shown in Table 6.

Data from a certified registration are eligible for the Worst in Class designation in a particular month when the data from the registration meet one or more of the following three conditions: 1) The data represent 2% or more of the sum of the denominators for that measurement over the time window. 2) For certain measurements and product categories, the data are greater than a non-zero threshold as shown in Table 6. 3) The data from the registration represent 5% or more of the sum of the numerators for that measurement over the time window.

Data from a certified registration are eligible for the Industry Average calculation in a particular month when the data are eligible for the Best-in-Class designation. If data are excluded from the Best-in-Class calculation or Worst-in-Class calculation, they are also excluded from the Industry Average calculation.

The NPRs denominator is used to determine eligibility for the FRT, OFR, CPQ, FPQ, MIP, PPD and SWU measurements.

Rules for Zero Denominator Data

It is possible under TL 9000 for the denominator to be zero when calculating the output data points. There are two different cases

Both numerator and denominator are 0 – that is 0/0
Numerator is not zero but denominator is 0 – that is n/0

For example, if a registration had no problem reports to fix in a given month then they would report 0 for the number of problems fixed and also 0 for the number of problems to fix. This leads to the 0/0 condition.

The correct interpretation of these conditions is different depending on the measurement – the result could be interpreted as a ‘0’, ‘100%’, ‘Not Valid’, or ‘No Data’ as shown in Table 1.

Table 1 – Interpreting Zero Denominators

Measurement	**Defined value**		**Comments**
	0/0	**n/0**	
NPR1,2,3	Not valid	Not valid	Correct data entry is "NA" for cases where there is no field population except for product categories 3.1.1.1.1 and 3.1.1.2.1 where the NU is "None"
NPR4	No data	n/1	Product Category 7 & 8
NPR4	Not valid	Not valid	Product Category 9
FRT2,3,4	100%	Not valid	
OFR2,3,4	100%	Not valid	
OTIS	No data	Not valid	
OTI	No data	Not valid	
OTS	No data	Not valid	
SO (SO1-4)	No data	Not valid	Correct data entry for 0/0 is "NA"
SONE (NEO1-8)	No data	Not valid	Correct data entry for 0/0 is "NA"
SOCCS (CCS1-4)	No data	Not valid	Correct data entry for 0/0 is "NA"
SONA (NAO1-4)	No data	Not valid	Correct data entry for 0/0 is "NA"
EOF/IOF	No data	n/1	
ERI,YRR, LTR	No data	Not valid	There should be data for at least 1 of the three return rates or all three data entries should be "NA" or "EXEMPT"
NYR	No data	n/1	n/1 is an unlikely event and should trigger question
RAAx	No data	Not valid	
RAPx	No data	Not valid	
CPQx/FPQx	0%	n/n	
MIPx	0%	Not valid	
PPDxx	NA	NA	Single value measurement, no denominator
SWUx	Not valid	Not valid	
SQ1	No data	Not valid	
SQ2	No data	n/n	This equates to 0% successful
SQ3	No data	n/n	This equates to 0% successful
SQ4	No data	Not valid	
SQ5	No data	n/n	This equates to 0% successful

These interpretations are based on

- TL 9000 Measurements Handbook 3.5
- Rewarding desired behavior, e.g. no patches had to be issued, etc.
- Not rewarding undesired behavior, e.g. patch defect found in later months

Application of the rules is as follows:

No data	Ignore the data in monthly and summary data calculations
Not valid	Fail the data submission
n/1	Treat as if the monthly data submission denominator had been 1. In summary calculations across months, use actual denominator(s) as soon as they are non-zero
n/n	Treat as if the monthly data submission denominator had been n. In summary calculations across months, use actual denominator(s) as soon as they are equal to or greater than n

Example A – Ramp-up Rules for Smoothed Data

The following is an example of the application of the ramp-up rules. It is shown for the OTIS measurement but applies for any measurement that has a 12-month time window.

For the example, assume that at time = 0, no certified registrations reported data for the specific product category. In Month 1, 5 new certified registrations reported data and continued through Month 12. Furthermore, the five certified registrations are from three companies. A 6th certified submission submitted data in Month 4 and a 7th certified submission submitted data in Month 6. Assume that the input data for the DSa and DSd data objects submitted are as shown in Table 2.

Table 2 – OTIS Data Inputs

DSa - # Installed Sys Accepted	Data Obj. #1	Data Obj. #2	Data Obj. #3	Data Obj. #4	Data Obj. #5	Data Obj. #6	Data Obj. #7
Month 1	34	40	36	36	50	Uncertified	Uncertified
Month 2	35	40	38	36	40	Uncertified	Uncertified
Month 3	36	40	40	36	45	Uncertified	Uncertified
Month 4	37	41	38	36	50	28	Uncertified
Month 5	38	41	36	37	45	27	Uncertified
Month 6	39	41	34	37	40	26	38
Month 7	40	32	32	37	30	25	39
Month 8	41	32	30	37	20	26	40
Month 9	42	32	30	38	26	27	42
Month 10	43	30	36	38	35	28	42
Month 11	44	30	38	38	33	29	44
Month 12	45	30	40	38	32	30	44

DSd - # Installed Sys in Month	Data Obj. #1	Data Obj. #2	Data Obj. #3	Data Obj. #4	Data Obj. #5	Data Obj. #6	Data Obj. #7
Month 1	36	43	38	39	52	Uncertified	Uncertified
Month 2	37	43	40	39	42	Uncertified	Uncertified
Month 3	38	43	42	39	47	Uncertified	Uncertified
Month 4	39	44	40	39	52	31	Uncertified
Month 5	40	44	38	40	47	30	Uncertified
Month 6	41	44	36	40	42	29	40
Month 7	42	35	34	40	32	27	41
Month 8	43	35	32	40	22	28	42
Month 9	44	35	32	41	28	29	44
Month 10	45	33	38	41	37	29	44
Month 11	46	33	40	41	35	30	46
Month 12	47	33	42	41	34	31	46

Since there are more than 3 data objects reported from 3 companies, the Monthly Average for OTIS can be reported starting in Month 1. It is calculated from the data in Data Objects 1-5. In Month 4, it also includes the Data Object 6 and in Month 6 it includes Data Object 7.

A summary of the OTIS value for the different Data Object Submissions and the OTIS Monthly Average are shown in Table 3.

Table 3 – OTIS Monthly Data Outputs

OTIS = 100*(DSa/DSd)	Data Obj. #1	Data Obj. #2	Data Obj. #3	Data Obj. #4	Data Obj. #5	Data Obj. #6	Data Obj. #7	Monthly Average
Month 1	94.44	93.02	94.74	92.31	96.15	Uncertified	Uncertified	94.23
Month 2	94.59	93.02	95.00	92.31	95.24	Uncertified	Uncertified	94.03
Month 3	94.74	93.02	95.24	92.31	95.74	Uncertified	Uncertified	94.26
Month 4	94.87	93.18	95.00	92.31	96.15	90.32	Uncertified	93.88
Month 5	95.00	93.18	94.74	92.50	95.74	90.00	Uncertified	93.72
Month 6	95.12	93.18	94.44	92.50	95.24	89.66	95.00	93.75
Month 7	95.24	91.43	94.12	92.50	93.75	92.59	95.12	93.63
Month 8	95.35	91.43	93.75	92.50	90.91	92.86	95.24	93.39
Month 9	95.45	91.43	93.75	92.68	92.86	93.10	95.45	93.68
Month 10	95.56	90.91	94.74	92.68	94.59	96.55	95.45	94.38
Month 11	95.65	90.91	95.00	92.68	94.29	96.67	95.65	94.46
Month 12	95.74	90.91	95.24	92.68	94.12	96.77	95.65	94.53

As noted above, even though OTIS is identified as a 12-month window for smoothing, reporting starts after 6 consecutive months of data. Since the rules for minimum data points necessary for reporting are met in Month 6, Best In Class, Worst In Class, and Industry Average can also be reported. Based on the data submitted, the Best In Class Object is the one highlighted in green below (Object 5 in Month 6). The Worst In Class is the one highlighted in red (Object 4 in Month 6). The companies from Data Objects 1-5 could also calculate their smoothed OTIS to support their quality system in Month 6. Data Object 6's company could start reporting internally a smoothed OTIS in Month 9 and Data Object 7's company could start in Month 11. Of course, as time continues, the smoothed OTIS calculation uses all certified data until a full consecutive 12-month window is filled (that is Months 1-12 for Data Objects 1-5 in our example). Going forward to Month 13, Data Objects 1-5 will use only Months 2-13 in their calculation. A summary of the OTIS smoothed output values for the different submissions is shown in Table 4.

Table 4 – OTIS Smoothed Data Outputs

12 Mnth Window OTIS (Start Calc After 6 Months)	Data Obj. #1	Data Obj. #2	Data Obj. #3	Data Obj. #4	Data Obj. #5	Data Obj. #6	Data Obj. #7	Industry Average
Month 1	N/A	N/A	N/A	N/A	N/A	Uncertified	Uncertified	N/A
Month 2	N/A	N/A	N/A	N/A	N/A	Uncertified	Uncertified	N/A
Month 3	N/A	N/A	N/A	N/A	N/A	Uncertified	Uncertified	N/A
Month 4	N/A	N/A	N/A	N/A	N/A	N/A	Uncertified	N/A
Month 5	N/A	N/A	N/A	N/A	N/A	N/A	Uncertified	N/A
Month 6	94.81	93.10	94.87	**92.37**	**95.74**	N/A	N/A	93.96
Month 7	94.87	92.91	94.78	**92.39**	**95.54**	N/A	N/A	93.86
Month 8	94.94	92.75	94.67	**92.41**	**95.24**	N/A	N/A	93.76
Month 9	95.00	92.62	94.58	92.44	**95.05**	**91.38**	N/A	93.68
Month 10	**95.06**	92.48	94.59	92.46	95.01	**92.12**	N/A	93.77
Month 11	95.12	**92.36**	94.63	92.48	94.95	92.70	**95.33**	93.89
Month 12	95.18	**92.26**	94.69	92.50	94.89	93.18	**95.38**	94.03

Best in Class Submission For Month n
Worst In Class Submission For Month n

Table 5 – Measurement Smoothing Windows and Optimum Values

Measurement	Time Window in Months	Optimum Value
NPR – Number of Problem Reports	6	0
FRT – Fix Response Time	6	100 %
OFR – Overdue Fix Response Time	6	100 %
OTIS – On-Time Delivery for Systems	12	100 %
OTI – On-Time Delivery for Line Items	6	100 %
OTV – On-Time Delivery for Service	6	100 %
SO – Service Impact System Outage	12	0
SONE – Network Element System Outage	12	0
SONA – Network Administration System Outage	12	0
SOCCS – Common Channel Signaling System Outage	12	0
EIO – Engineering/Installation System Outage	12	0
FR – Field Returns	12	0
RAA – Release Application Aborts	6	0
RAP – Release Application Problems	6	0
CPQ – Corrective Patch Quality	6	0
FPQ – Feature Patch Quality	6	0
MIP – Manual Intervention Patches	6	0
PPD – Patch Propagation Delay	6	0
SWU – Software Update Quality	6	0
SQ – Service Quality	12	100 %

Table 6 – Inclusion Rule Threshold Values (Alternative to 2%)

PC #	Product Category Name	NPR	FRT	OFR	OTI	SO	SONE	SOCCS	SONA	Return Rate
1.1	Circuit Switch	100	120	120	600	0	100	100	NA	25000
1.2.2	Access Switch	100	120	120	600	0	100	NA	NA	25000
3.1.1.1.1	Metalic Conductor Cable	0	120	120	600	NA	NA	NA	NA	NA
3.1.1.2.1	Fiber Optic Cable	0	120	120	600	NA	NA	NA	NA	NA
3.1.1.2.2	Optical Connectors	0	120	120	600	NA	NA	NA	NA	NA
3.1.2.1	Enclosures	0	120	120	600	NA	NA	NA	NA	10000
3.2.2.1.2.1	SONET/SDH	250	120	120	600	0	250	NA	NA	40000
3.2.2.1.2.2	WDM/DWDM	250	120	120	600	0	250	NA	250	40000
3.2.2.2	Loop Carrier	1000	120	120	600	0	1000	NA	100	10000
3.2.4	DSL	500	120	120	600	0	500	NA	500	50000
3.3.2	Base Transceiver System	250	120	120	600	250	250	NA	NA	5000
6.2.1.2	Wireless Sunscriber User	100000	120	120	600	NA	NA	NA	NA	10000
6.2.3	Data Modems	50000	120	120	600	NA	NA	NA	NA	10000
7.1	Installation Service	0	120	120	600	NA	NA	NA	NA	NA
7.4	Repair Service	0	120	120	600	NA	NA	NA	NA	NA
8.1	Components	250000	120	120	600	NA	NA	NA	NA	NA
8.2.3b	High Complexity Assembli	250000	120	120	600	NA	NA	NA	NA	NA
8.2.4b	Very High Complexity Ass	250000	120	120	600	NA	NA	NA	NA	NA

0 Only use 2% Rule
NA Measurement is Not Applicabile
Non-zero # Include if denominator is > 2% of total population denominator OR > this number